1. Introduction and objectives

Quality-centered and environmentally-friendly fruit production requires the establishment of smaller sized trees and higher density plantations for almost every fruit species. Apart from producing excellent quality, the greatest challenge in sweet cherry production is to achieve small, intensive crown size. Most of the rootstocks with moderate growth do not reduce size enough to allow harvest and pruning without a ladder. In addition, many of these rootstocks are sensitive to drought and/or frost and, in many cases, there are compatibility problems with the grafted cultivars. Practical experience with dwarf rootstocks (e.g. Gisela 5) has shown that senescence is rapid, regeneration ability is reduced and the quality and quantity of fruit are worse for every grafted cherry cultivar, which questions their suitability for cherry production in Hungary.

It is important to study the relationship between traditional strong rootstocks and the increase in intensity we are considering. According to experience, rootstocks with strong growth have significantly better regeneration ability at maturity (regeneration of the productive parts, frequency of new branch formation) than rootstocks with weaker growth.

A combination of the increase in the favourable exposure time and the smaller crown sizes (*Figure 1.*) makes the higher tree-densities (tree/ha) and the better utilisation of the crown (specific cropload) possible.

The smaller crown-size assures almost 100% exposure to sunlight and the same fruit quality on every part of the tree. The cropping surface is located close to the central axis, thus also to the vascular tissues, making the nutritional supply more favourable. The flower- and fruit nourishing improves and, with this, the crop safety also. The effectiveness of plant protection techniques are improved and it also gives the opportunity to apply environmental friendly technologies more successfully. The phytotechnical and harvest work can be performed more safely and faster, the effectiveness of phytotechnical actions improves, respectively the proportion of good quality hand-picked fruits too.

In the intensive growing technology of sweet cherry, during the establishment of the required productive surface the cultivar is important in determining the growth vigor, the branching ability, respectively the specifics of quantity and quality of bud-formation.

Figure 1. Extensive and intensive sweet cherry plantations

Beside assuring the quality of fruit, marketable size and excellent consumption value, special emphasis is laid on determining the suitability of the cultivars for intensive production.

According to previous experience, our hypothesis is that those cultivars which were suitable for intensive production, establish and maintain high density and smaller crown-sized trees which:

- in parallel with a *thick central axis*,
- possess *thin side-branches,* their
- total length, *branching ability thus the number of growing points are high*, which
- *has high bud-density*, among those
- *high portion of flower-buds,* and of course
- the *yearly crop quantity and quality* suits the requirements.

In the ecological characteristics of the north part of the Great Plain, we have examined the potential of increasing the intensity, using *Prunus mahaleb* rootstock, which is excellently adapted to the Hungarian environment and also has a stronger growth.

Our aims were to examine the vegetative and reproductive characteristics of different sweet cherry cultivars, in which knowledge we are able to recommend those cultivars which can be used to establish intensive (mainly to string-spindle) crown forms and its safe maintenance. We try to identify with high-numbered data those cultivar specifics which that knowledge helps to select for intensive production.

In our work we have studied the effects of high density, intensive summer pruning and the influence of the cultivars on the vegetative and reproductive attributes. On the basis of some indices, we aim to identify those cultivars that allow the establishment of intensive orchards even for rootstocks of strong growth with dense spacing pattern.

2. Material and methods

The experimental sweet cherry plantation is located at the Pallag Experimental Station of the University of Debrecen (47° 59' N, 21° 64' East). The experimental area represents well the ecological environment of the southern 'Nyírség'. The soil is of sandy texture with a slightly acidic pH and a content of organic matter of 1,0% . The cultivation was carried out under irrigation.

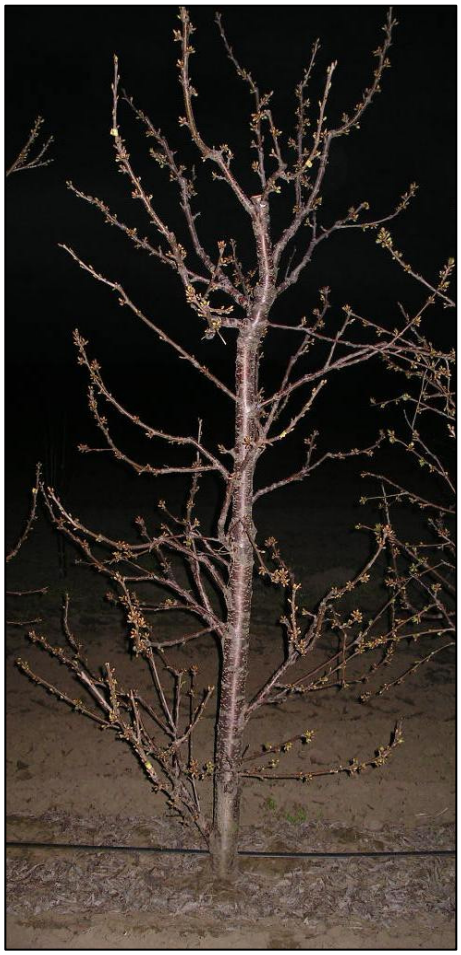
The examination contained 20 different cultivars, some already used in commercial production: 'Aida', 'Axel', 'Bigarreau burlat', 'Germersdorfi 3', 'Katalin', 'Linda', 'Margit', 'Münchebergi korai', 'Solymári gömbölyű', 'Szomolyai fekete', 'Van', 'Vera', and some still in trials, known only with numbers, hybrids: A-1, 11/108, 41/104, 41/51, 006/17, 6/66, 6/78, 6/99.

The trees were grafted onto *Prunus mahaleb* (C 500) rootstock and the planted material was one year old saplings (graft without branching). The sweet cherry orchard was established in spring 2000.

The applied crown form is string spindle with side branches along the dominant central axis, depending on the cultivar, either from the ground level, or above a shorter or longer trunk.

Treatments

In the year of planting no pruning was performed. In the following year, pruning was performed during the vegetative period. When the longest shoots reached a length of 0.35-0.40 m all shoots were pruned to half their length along the central axis. When 1-3 shoots from the apical buds of the pruned shoots reached 0.35-0.40 m (within 4-6 weeks), these were again pruned to half their length in the same way and at the same time for all cultivars. This treatment was repeated once again on the most vigorous cultivars. The summer pruning resulted in an increase in the second and third grade branches, gradually filled in the given space and formed the 1m diameter, 2,5m in height string spindle crown form (*figure 2*).



In 2002, the same pruning treatments were repeated on 9 May, 12 June, and 23 July.

By the third year all the trees had reached 1 m in diameter. In that year the woody parts of the lateral branches also had to be pruned to some extent. They were pruned back to the shoots developed in the previous year.

In 2003 summer prunings were performed on two occasions, 20 May and 8 July.

Our aims were that the trees should not grow into each others' living space and that the crown should not become too dense, but rather should be well exposed.

With the summer pruning performed 2-3 times per year, 10-15% of the foliage was removed on each occasion.

Figure 2. The tree of cultivar 'Germersdorfi 3' in the spring of 2005.

To moderate the height of the crown, we performed pruning in the spring before budbreak. We cut back the top part to one of the side branches in a favourable position. In the following years the summer pruning was delayed; we started a little bit later to decrease the frequency of pruning treatment.

The data of summer prunings:

- *2004: 26 May; 26 July.*
- *2005: 1 June; 21 July.*
- *2006: 25 May; 28 July.*

In 2006 at the second occassion of summer pruning there was no cutting back to half, only thinning.

Figure 3. The new growing points have formed on the central axis.

For the string spindle crown form the regeneration ability and the formation of newer growing points on the central axis are important factors. The summer pruning after the crown form has developed has an important role with thinning the periphery. In this manner the shoots and bud-clusters forming right on the central axis can receive enough sunlight (*Figure 3.*).

We have determined the height of the trees at 2,5 – 3,0 m, thus the main portion of the phytotechnical and harvest work can be performed standing on the ground, which is easier, safer and faster.

During the experiment we made measurements to define the vegetative and generative characteristics. The trunk diameters measured 0,25 m above the graft union. On the central axis the thickness was measured at a further four points. From the collected data (the number, position and the thickness of side branches, the number of new shoots caused by the pruning treatment, the number of buds on the each section and the bud quality, the number of flowers), we have created relative numbers to be able to compare the cultivars. We have measured the frost injury, the shoots- and the fruit development, the crop and the fruit parameters.

During the development of the convenient productive surface for the intensive production of sweet cherry, the role of the cultivar is in the growth manner, the inclination towards branching ability and in the quantity and quality of bud formation.

We have found great differences among the cultivars.

3. Results

The growth of the trunk cross sectional area

After the second year the trees had trunks of different thicknesses typically depending on the cultivar. In the following years, the highest increase in the trunk cross sectional areas was found during 2002. In the years after, the degree of growth moderated (*Figures 4 and 5*).

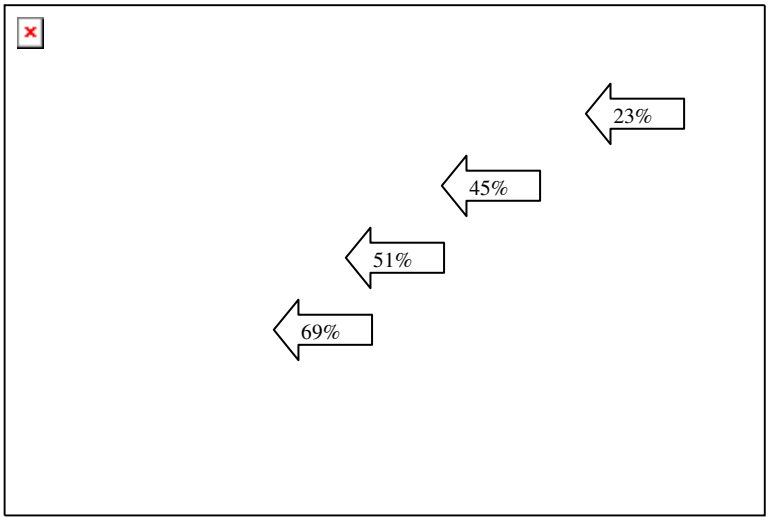


Figure 4. The changes in the trunk cross sectional area of cultivar 'Axel' between 2001 and 2005 (Debrecen-Pallag).

The cultivar 'Münchebergi korai' had the thickest trunk while the cultivar 'Linda' was the thinest (*Figure 5*). The 'Axel', 'Katalin', a 41/51, 6/17, 11/108, 6/66, 'Germersdorfi 3', 'Bigarreau Burlat', A-1 and the cultivar 'Aida' are in the weak - medium strong category, the cultivars 'Margit', 'Solymári gömbölyű', 'Van', 'Szomolyai fekete', 41/104, 6/99, 'Vera' 6/78 belong to the medium strong – strong category. Because of the close spacing of that type of intensive orchard we have examined, those cultivars can be suggested in which growth is inclined to be weak or medium strong.

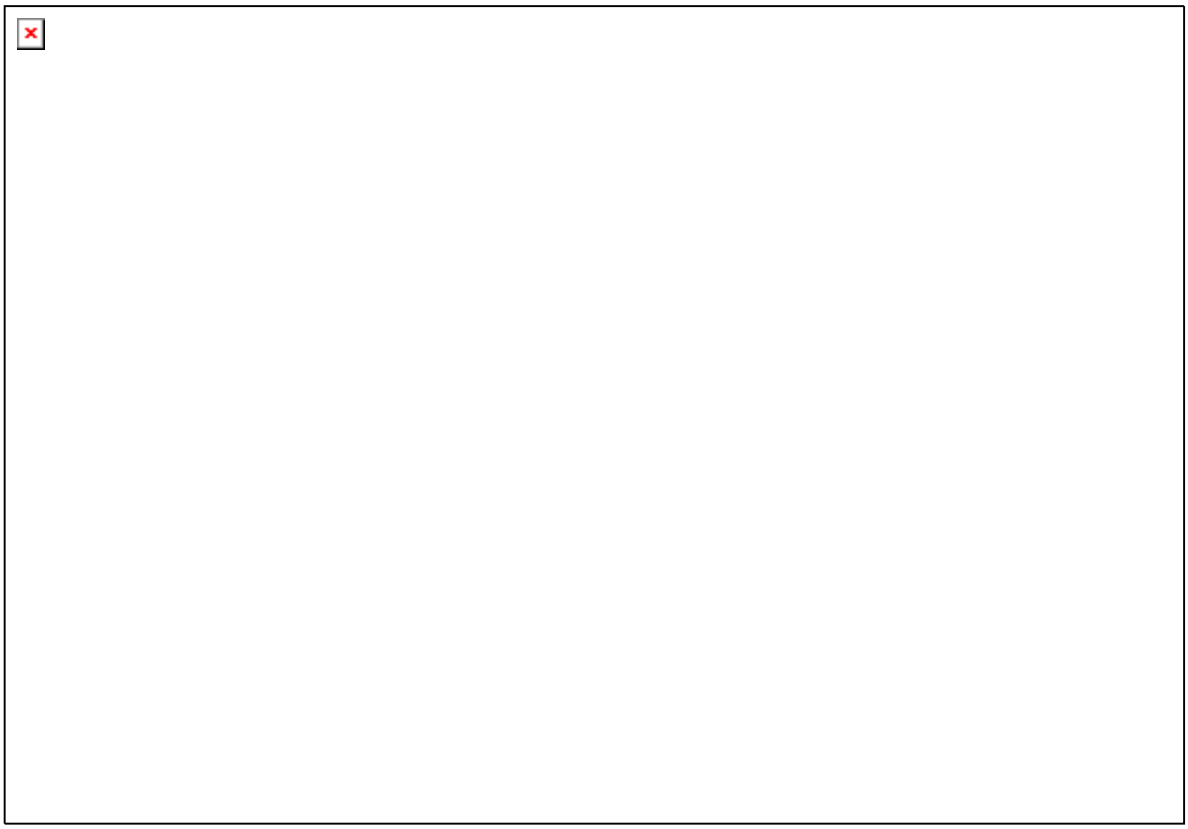


Figure.5. The changes of trunk cross-section areas of sweet cherry cultivars between 2001 and 2005 (Debrecen-Pallag, Hungary).

The growth of the central axis

The average cross-sectional area of the central axis demonstrates the differences of tree vigour among the cultivars. Most of the cultivars has almost the same strong central axis. The cultivar 'Münchenergi korai' parallel with the trunk, also had the thickest and the cultivar 'Linda' the thinest central axis (*Figure 6*).

The cubic content measured up to 2 m height of 41/51, A – 1, 'Bigarreau Burlat', 006/17, 'Axel', 6/66, 'Germersdorfi 3', 11/108, 'Katalin', 41/104 has varied between 7 and 8 dm^3 at the end of 2005. The cultivars 'Aida', 'Margit', 'Solymári gömbölyű', 6/99, 'Van', 'Szomolyai fekete', 'Vera' and 6/78 had a little stronger central axis. The cultivars, except 41/104, belonged to the same categories as by the trunk cross sectional areas.

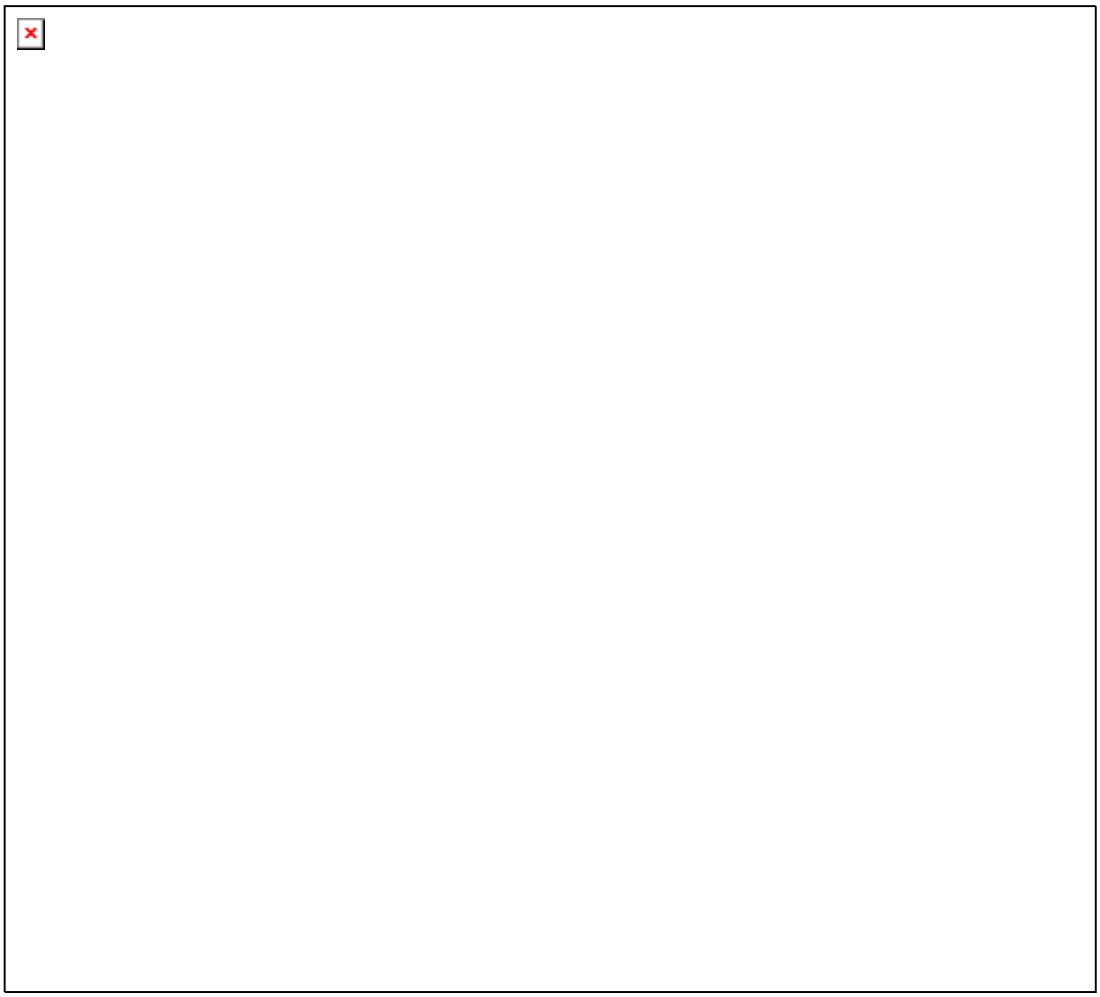


Figure 6. The changes in the cubic content of the central axis of the sweet cherry cultivars (Debrecen-Pallag).

Branches

The trees after planting had sprouted out in different rate.

The cultivars which produced the most branches along the central axis are: 'Katalin', a 'Linda', and the 'Germersdorfi 3', while the majority of the cultivars had an average of 13-17 branches. The average cross sectional areas of the branches measured close to the central axis ranged between 1.2 and 4.9 cm^2 (*Table 1*). Most of the cultivars had a 3-5 cm^2 area, only five cultivars had lower value.

The relationship between the cross-sectional areas of the central axis and the lateral branches is shown in *Figure 7*. It can be stated that the thicker central axis has thicker lateral branches.

Table 1. The average cross-sectional area (ACSA) of the central axis (cm^2), the number of lateral branches on the central axis from the graft union to 2 m in height, and the average cross-sectional areas of lateral branches next to the central axis (cm^2) of 20 sweet cherry cultivars grown at Debrecen-Pallag, Hungary.

Cultivar	ACSA of the central axis (cm^2)	No. of lateral branches (pieces/tree)	ACSA of the lateral branches (cm^2)
Linda	10.83	23	1.18
Biggareau Burlat	17.61	11	3.27
Axel	21.97	14	3.64
006/17	22.30	10	2.46
6/66	22.51	13	3.36
11/108	22.96	18	2.23
Germersdorfi 3	23.21	22	2.43
A - 1	23.44	17	3.11
41/51	23.57	15	3.30
Katalin	24.64	24	2.17
Aida	26.83	17	3.32
6/78	27.57	13	4.93
41/104	27.82	15	4.22
6/99	27.88	14	4.04
Vera	27.98	12	4.27
Solymári gömbölyű	28.51	17	3.22
Van	29.07	13	4.15
Margit	29.08	19	3.29
Szomolyai fekete	29.55	17	3.39
Münchebergi korai	33.12	13	4.19
LSD, 5%	0,834	2,182	0,156

Figure 7. The relationship between the trunk cross-sectional area of the central axis and the cross-section area of lateral branches of 20 sweet cherry cultivars grown at Debrecen-Pallag, Hungary.

The indexes of the cross-sectional areas of the central axis and branches of the studied cultivars were lower than the figure of 0.5 that has been suggested for cherry by Zahn (1990). The difference is quite large among cultivars. The range of Zhan's index of thickness from 0.3 to 0.43 showed that there were large differences in growth vigour among cultivars. The larger indices represent those cultivars which can be more difficult to keep in the row and the cultivars with smaller indices are more suitable for intensive production (*Figure 8*).

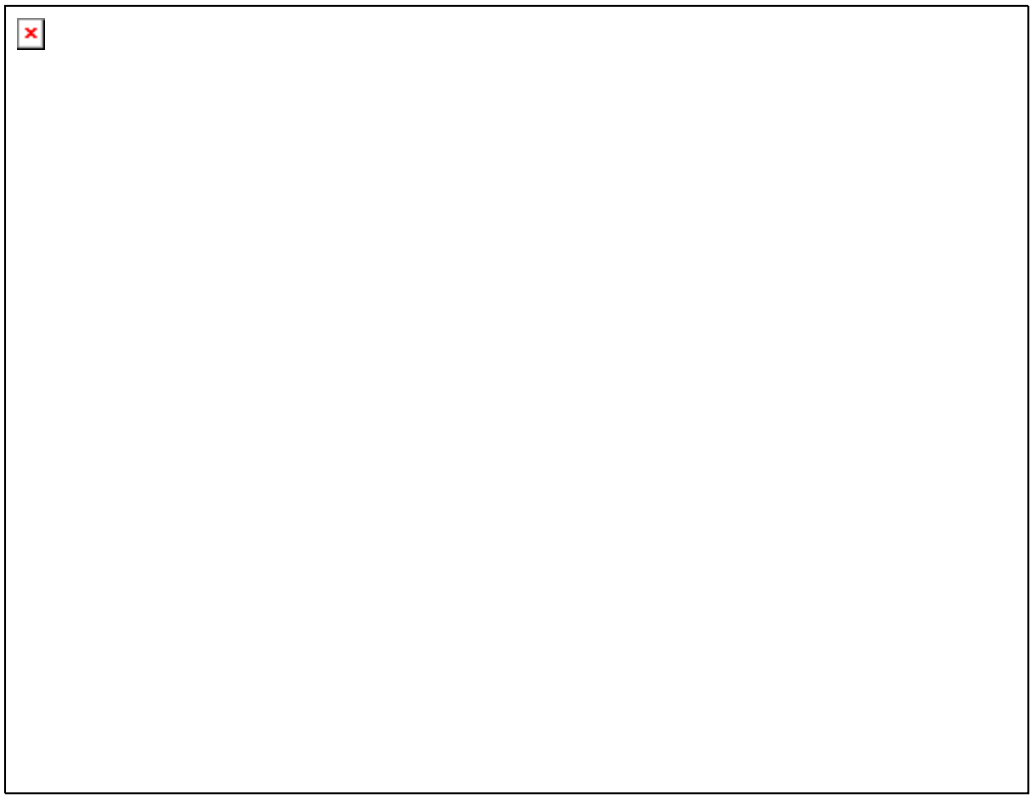


Figure 8. Zahn's indexes of sweet cherry cultivars (mm/mm)at the end of the 4th growing season.

Among sweet cherry cultivars which normally have acrotonic growth character, mesotonic, even basitonic branching inclined cultivars can be found. Prominently mesotonic branching inclined cultivars are: Münchebergi korai, Solymári gömbölyű, 11/108, A -1, but most of the cultivars produced branches, shoots on the middle third part of their central axis (*Figure 9*).

The most basitonically inclined cultivar was the 6/99 signed hybrid.

Figure 9. The positions of the growing points (branches, shoots) on the central axis (%) (Debrecen - Pallag, 2004. Hungary)

Bud formation

The buds of the sweet cherry can be reproductive (flower) or vegetative. Within the flower bud there are more flower primordias, depending on the cultivar and the climatic factors during the process of differentiation. The buds may stand alone or form groups (*Figure 10*).

Figure 10. Single buds, THRV, and bud cluster.

The bud clusters which are the highest valued are those in which the middle bud is vegetative and around them are flower buds. The vegetative bud ensures the basis for the next year's production, either forming a new bud cluster, or a longer shoot, developing flower buds close to its base.

Among the cultivars we can find differences in the first years in the relation of bud formation. By examining the different levels of the crown form, differences also can be found (*Figure 11*). Most cultivars forms the highest portion of their buds at the middle and upper part of the tree.

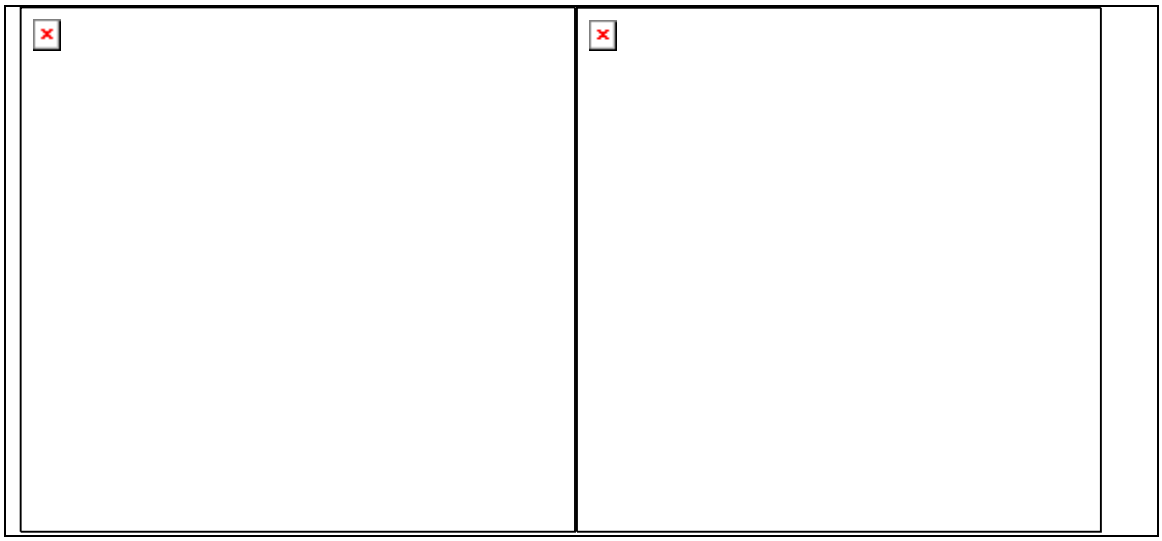


Figure 11. The percentage of bud-types in the different levels of the crown at the end of the second vegetation. The number of buds inside the columns. THRV= budform shown in the middle picture of Figure 10. (Debrecen-Pallag, 2001).

During the development of the crown form, with the increase in the number of branches, the number of buds also increases, but the bud density and the numbers of bud clusters are not higher in every case on those cultivars which have more branches. Bud clusters is a particular specific of the cultivar. The prominent cultivars in forming bud clusters are:'Van', A – 1, 'Linda', 'Germersdorfi 3', 'Katalin' and 41/51. In respect of buds per linear metre, the numbers between 18 and 34 shows big differences among the cultivars, but most of the cultivars can be characterised with relative bud numbers between 25 and 35. Compared to the data collected at the end of the second growing season, by the end of the sixth year the number of buds increased 4-6 times (*Table 2*.).

Table 2. Some characteristics of the cultivars perspective in intensive production, at the end of the sixth vegetation (Debrecen-Pallag, 2005).

Cultivar	branches	buds	Bud cluster
	average diameter (mm)	total piece/tree	total piece/tree
Vera	27,0	1685	84
Katalin	25,9	2857	149
Axel	26,7	2433	163
Van	28,1	2405	177
Aida	20,5	2251	217
Germersdorfi 3	19,1	2616	222
A - 1	22,8	2421	234
Linda	18,2	3007	304

The dynamics of the shoot-growth

Among the cultivars major differences can be found. The cultivar 'Szomolyai fekete' has very rapid growth (*Figure 12*). The Duncan-test (*Table 3*) has separated the cultivars into ten groups. The summer pruning can be scheduled by these groups.

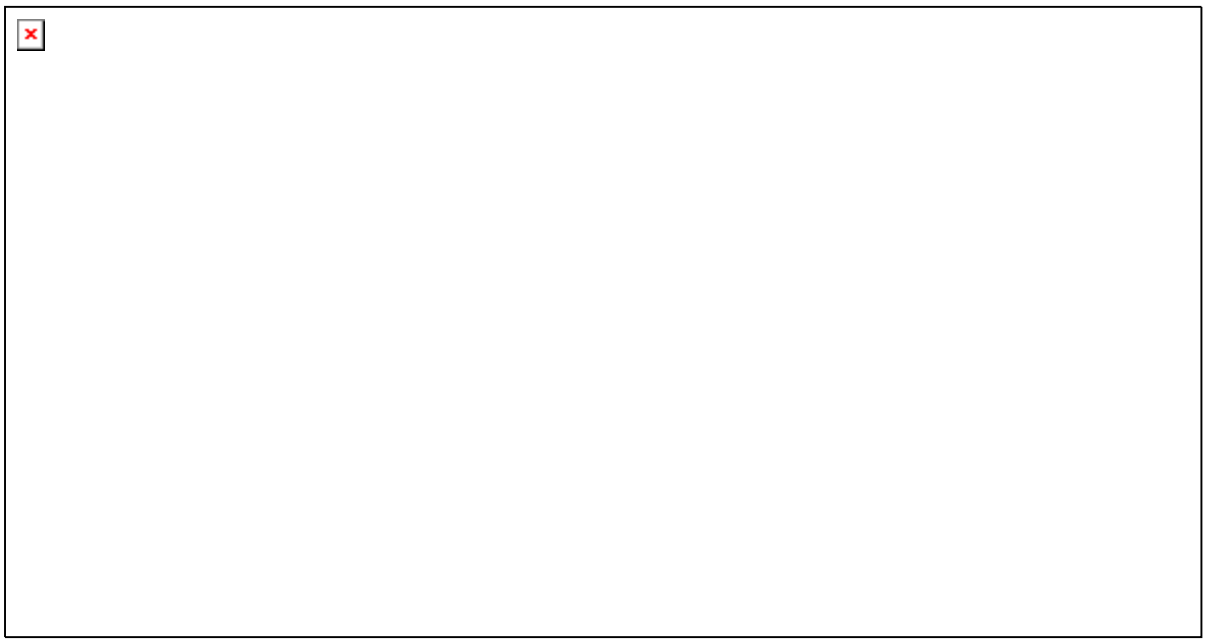


Figure 12. Shoot-growth dynamics(Debrecen-Pallag)

Table 3. Groups by the Duncan-test (shoot lenght)

	Cultivars	Subset									
		1	2	3	4	5	6	7	8	9	10
Duncan(a,b)	Bigarreau Burlat	17,875									
	Aida		24,875								
	Münchenbergi korai		25,375								
	006/17		26,25	26,25							
	6/78		28,125	28,125	28,125						
	Germersdorfi 3		28,375	28,375	28,375						
	Linda		29,625	29,625	29,625						
	6/99			31,375	31,375	31,375					
	Van				33	33	33				
	11/108					35,25	35,25	35,25			
	Vera					36,25	36,25	36,25			
	41/51					36,375	36,375	36,375			
	A - 1						37,375	37,375	37,375		
	6/66						38	38	38	38	
	Katalin						38,125	38,125	38,125	38,125	
	Margit							38,625	38,625	38,625	
	Solymári gömbölyű							38,75	38,75	38,75	
	41/104								42,5	42,5	
	Axel									42,875	
	Szomolyai fekete										54
	Significance?	1	0,0864	0,05925	0,073022	0,06584	0,06762	0,21978	0,0638	0,0782	1

Cultivars	*Linda*	*Münchebergi korai*	*Axel*	*11/108*	*41/51*	*6/99*	*41/104*	*Vera*	*Aida*	*Germersdorfi 3*	*Van*	*6/66*	*Bigarreau Burlat*	*Katalin*	*A - 1*	*Szomolyai fekete*	*Solymári gömbölyű*	*6/78*	*Margit*	*006/17*
Linda		AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	A	AKF	KF	AKF	AKF	AKF	AKF	AKF
Münchebergi korai	AKF		A	A	A	A	A	A	AK	AK	A	AF	KF	AF	AKF	AKF	AK	A	AK	A
Axel	AKF	A			A	K	K	AK	K	K		AF	AKF	F	AKF	AKF			A	K
11/108	AKF	A			A	AK	AK	AKF	K	KF		A	AKF	AF	KF	AKF		A	A	AK
41/51	AKF	A	A	A				F	K	AKF	A	A	AKF	F	AKF	K	K		AK	F
6/99	AKF	A	K	AK					K	F	K		AKF	F	AF	K	K		AK	
41/104	AKF	A	K	AK					K	A	K	F	AKF	F	AF	KF	K		AK	
Vera	AKF	A	AK	AKF	F				K	A	AK	F	AKF		A	KF	KF		AKF	
Aida	AKF	AK	K	K	K	K	K	K		K	K	AK	AKF	KF	KF	A		K	A	K
Germersdorfi 3	AKF	AK	K	KF	AKF	F	A	A	K		KF	AKF	AKF			AKF	KF	K	AKF	
Van	AKF	A			A	K	K	AK	K	KF		A	AKF	F	AKF	A			A	K
6/66	AKF	AF	AF	A			F	F	AK	AKF	A		AKF	F	AKF	K	A			F
Bigarreau Burlat	A	KF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF	AKF		AKF	AKF	AKF	AKF	AKF	AKF	AKF
Katalin	AKF	AF	F	AF	F	F	F		KF		F	F	AKF		A	KF	KF	F	AKF	
A - 1	KF	AKF	AKF	KF	AKF	AF	AF	A	KF		AKF	AKF	AKF	A		AKF	AKF	AKF	AKF	A
Szomolyai fekete	AKF	AKF	AKF	AKF	K	K	KF	KF	A	AKF	A	K	AKF	KF	AKF		A	KF	A	KF
Solymári gömbölyű	AKF	AK			K	K	K	KF		KF		A	AKF	KF	AKF	A		K	A	KF
6/78	AKF	A		A					K	K			AKF	F	AKF	KF	K		A	
Margit	AKF	AK	A	A	AK	AK	AK	AKF	A	AKF	A		AKF	AKF	AKF	AK	AK	AK		AK
006/17	AKF	A	K	AK	F				K		K	F	AKF		A	KF	KF		AK	

Figure 13. The differences in shoot growth after pruning in the different levels: lower third part (A), middle third part (K) and upper third part (F) of the crown.
(The letters (A,K,F) show in which part of the crown there were significant differences between the cultivars.
Yellow areas indicate those where no significant differences were found in any part)

Figure 13 compares the after pruning shoot growth — on the basis of shoot length at different levels of the crown — between cultivars. The letters (A,K,F) indicate in which part of the crown significant differences (by spss ANOVA) between the cultivars were found .

Reproductive characteristics

Appreciable quantities of flowers were already present on the trees in the third year. The flower numbers most frequently present were three in the flowerbuds. On the basis of this, counting with the data of cultivar 'Germersdorfi3', 100-110 fruits can be expected per tree.

In respect of relative/specific flower quantity (total buds on branch / cross section area of the branch) the cultivars 'Linda', 'Germersdorfi 3', 11/108 and A–1 are prominent, but the values of cultivars 'Van', 'Katalin', 'Aida', 41 / 51 and 'Axel' were also good in 2004 (*Figure 14*).

Figure 14. The quantity of flowers in relation to the cross section areas of side branches (flower piece/cm^2)(2004).

Table 4. The flower density of sweet cherry cultivars in 2006 (Debrecen-Pallag)

(Range between 0 and 5, the number 5 is the most dense)

Fajta	*flower-density*
Linda	5,0
Germersdorfi 3	5,0
Katalin	5,0
Aida	5,0
41/104	4,8
Axel	4,5
11/108	4,5
A - 1	4,5
Van	4,3
6/66	3,8
6/99	3,8
41/51	3,7
Vera	3,5
6/78	3,5
Margit	3,4
006/17	2,6
Bigarreau Burlat	2,3
Szomolyai fekete	2,3
Münchebergi korai	2,0
Solymári gömbölyű	2,0

The cultivars 'Linda', 'Germersdorfi 3', 'Katalin' (*Figure 15.*) and 'Aida', which all scored 5, had the highest flower density.

The flower density of 41/104, 'Axel', 11/108, A–1 and the cultivar 'Van' are also good.

The cultivars that produced the least flowers were 'Bigarreau Burlat', 'Szomolyai fekete', 'Münchebergi korai' and 'Solymári gömbölyű' (*Table 4*).

Figure15. The cultivar 'Katalin' in full bloom. (2006).

Frost tolerance

Amongst the cultivars in 2003 and in 2005, after the effect of hard winter freeze in the respect of flower bud injury, the cultivar 'Linda' proved to be tolerant to winter frost. Thus this cultivar can in particular be suggested to be grown in the environment of the north of the Great Plain.

Yield

Based on the yield of 2004, there are big differences among the cultivars. We have grouped the cultivars into three category (*Table 5).*

Table 5. The categories of the cultivars based on their yield (Debrecen-Pallag, 2004)

	Yield kg / tree	Cultivars
Low	0-2	Münchebergi korai, Szomolyai fekete, 6/17, Bigarreau burlat, Margit, 6/78, 41/104, 6/99
Medium	2-3	Solymári gömbölyű,
Good	3 <	Katalin, Van, Vera, Germersdorfi 3, Axel, Linda, A - 1, 11/108, Aida, 41/51

In the year 2004, the most productive cultivars were A - 1 (15,25 t/ha), Linda (11,96 t/ha), Axel (11,7 t/ha), Germersdorfi 3 (9,45 t/ha), Vera (9,4 t/ha), Van (7,94 t/ha), and Katalin (7,55 t/ha) (2500 trees/ha). Comparing to data in the literature, the size of the fruits were similar in the cases of cultivars 'Axel', 'Linda', 'Germersdorfi 3', and 'Margit'. On average the size of the fruit of cultivar Katalin' was sligtly smaller, but the value of modus was 25 mm. The cultivar 'Aida' has not reached the size 27-29 mm, but conversely the cultivars 'Solymári gömbölyű', 'Van' és 'Vera' had better parameters than written in the literature.

During the winter of 2006 the buds did not suffer flower bud injuries. The spring and the beginning of summer however were not favourable for sweet cherry trees. The first two weeks of June were cool (9-12ºC) and rainy. By this time, the early ripening sweet cherries mostly had developed (Figures *16. 17.*), but among the later ripening cultivars, some of them ('Katalin', 'Germersdorfi 3', 'Linda') had fruit dropping in a high rate.

In respect of the rate of the fully developed fruits and the fruits dropped right after the stone cover has developed (called mummies hereafter) great differences occurred among cultivars. While on the most branches 2-3% of the flowers developed fully into fruit, the fruit/mummy rate was 29/71% of the cultivar 'Katalin', in the case of A-1 the rate was 73/27; and the 41/51 signed hybrid's rate was 90/10. This effect can be caused by many reasons (such as unfavourable weather during differentiation of buds, nutrient disorder, boron deficiency during bloom, or might be a second infection of *Monilinia*), but the development of the embryo in these fruits stopped.

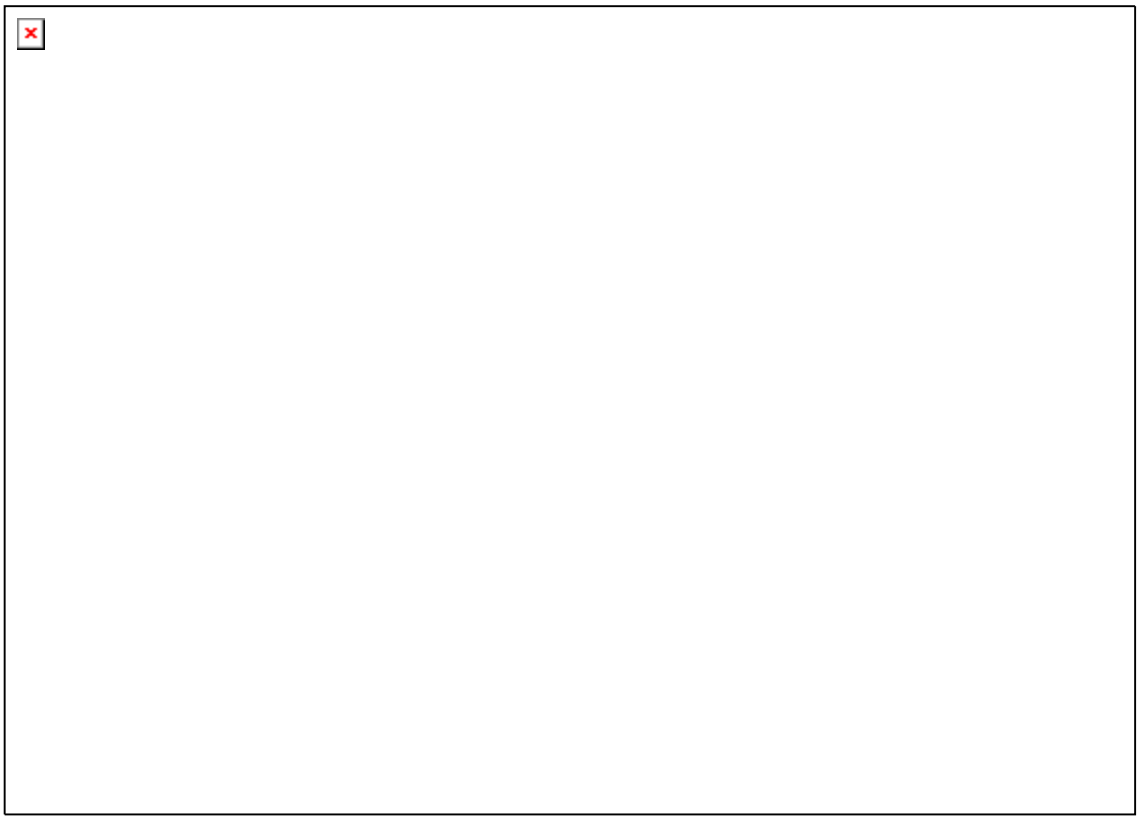


Figure 16. The dynamics of fruit development of earlier ripening cultivars

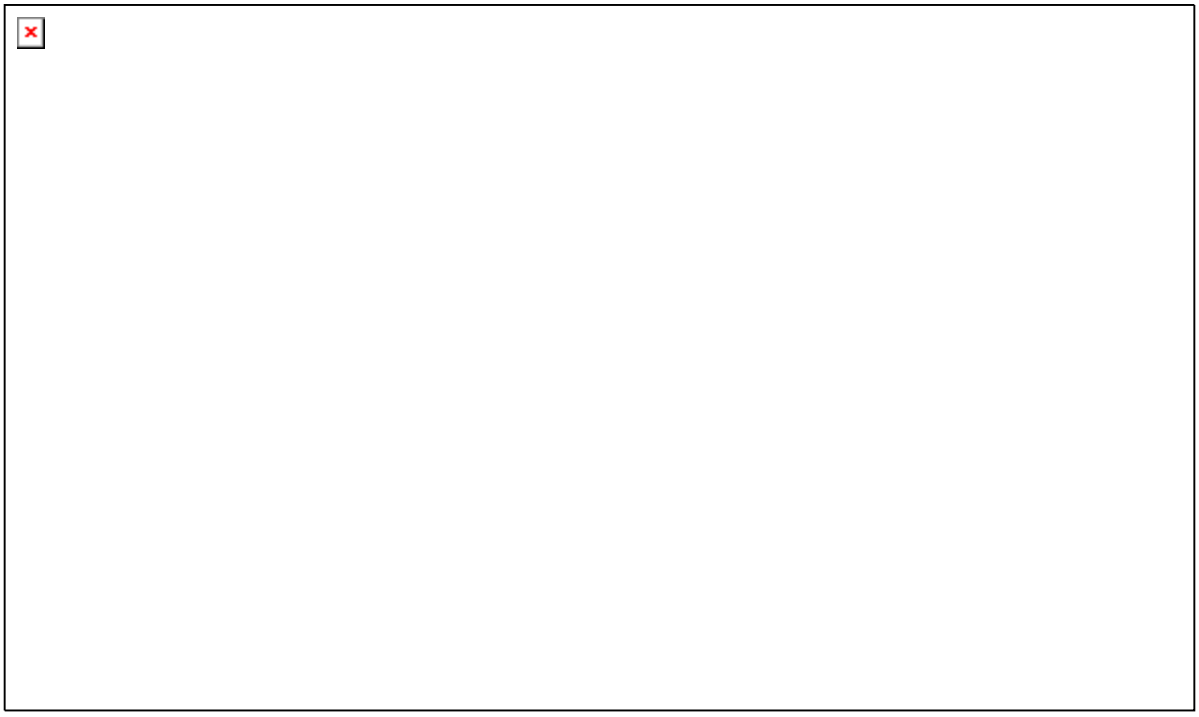


Figure17. The dynamics of fruit development of later ripening cultivars

Table 6. gives an overview of the crop in 2006. The table does not contain the data of 'Germersdorfi 3', 'Katalin' and 'Linda' cultivars, because of the high rate of fruit dropping. In the cases of the other cultivars the rates among the number of flowers, the dropped fruits and the fully developed fruits did not show any disorder, thus the fruit quantity and parameters are acceptable.

Table 6. Sweet cherry cultivars categorised by the yield and its fruit diameter (mm) (2006).

Yield		**Cultivars**	**Fruit size**
(kg/tree)	(t/ha)		**diameter** (mm)
2kg >	max. 5,0	Margit	28,6
		Bigarreau Burlat	26,3
		Münchebergi korai	27,1
		6/99	24,6
2-4kg	5,0-10,0	Szomolyai fekete	21,2
		006/17	25,6
		Solymári	20,6
		6/78	26,9
4-6kg	**10,0-15,0**	**Vera**	**26,2**
		6/66	**25,6**
		Aida	**24,9**
		41/104	**24,6**
		11/108	**26,2**
		Van	**25,9**
6-10kg	**15,0-25,0**	41/51	23,7
		A - 1	23,4
		Axel	**24,5**

The members of the 10-15 t/ha yield group: 'Vera', 6/66, 'Aida' (*Figure 18.*), 41/104, 11/108, and the cultivar 'Van' (with red coloured letters in the *Table* 6) in the sixth growing period of the plantation, has produced convenient quantity and marketable (25-26 mm) sizes.

Figure 18. The fruit of the cultivar 'Aida'.

In the group of 15-25 t/ha yield, the size of the fruit of two hybrids highlighted with a green area in Table 6, unfortunately did not reach 24mm in diameter. In the case of A-1, probably caused by the big crop load, since the data from earlier year showed the average fruit size was above 24mm. The fruit diameter of 41/51 signed hybrid conversely, in the earlier year, was smaller.

From this group the cultivar 'Axel' (*figure* 19) is prominent, which is a late ripening, self-fertile Hungarian cultivar had a good yield and marketable fruit size.

Figure 19. The fruit of the cultivar 'Axel'

4. New and novel results

- **Among the cultivars there are great differences in the early years in the growing incline and in the early fruit bearing. The knowledge of this can promote the early determination of the cultivars suitable for intensive technology in the years following plantation.**

- **The productiveness of the cultivar only partially depends on the growth vigour, growth manner, acrotonic or basitonic inclination towards branching ability, which are rather determined by the specifics of the cultivar.**

- **The indexes of the cross-sectional areas of the central axis and branches of the studied cultivars were lower than the figure of 0.5 that has been suggested for cherry by Zahn (1990), and can be related to a favourable characteristics of this crown form.**

- **On the basis of the growing characteristics we have separated the cultivars into groups. The knowledge of the growth clusters helps the association of cultivars, to be able to do summer pruning at the same time, or on the contrary, to prolong the pruning intervention, avoid the dumping-like work.**

- **On the basis of the yield and fruit size we ranked the cultivars into four groups, and defined the cultivars with good fruit quantity and quality that are suitable for intensive production.**

- **On the basis of our results, the cultivars that should be recommended for high density plantation on *Prunus mahaleb*, on string spindle crown are the following: 'Linda', 'Axel', 'Germersdorfi 3', 'Vera', 'Van', 'Katalin', 'Aida'.**

- **Among the examined cultivars, the most prominently frost resistant, which thus has the best crop safety, is the cultivar 'Linda'.**

5. Results that can be adopted in practice

- **The string spindle crown form on a strong growth rootstock and in the ecological environment of South-Nyírség can be developed and maintained well.**

- **The cultivars recommended for string spindle crown form are: 'Linda', 'Axel', 'Germersdorfi 3', 'Vera', 'Van', 'Katalin' and 'Aida'.**

- **For the areas where damage may occur by frost, the cultivar 'Linda' can be recommended.**

- **Our results help (in the knowledge of growth characteristics) the optimal combination of cultivars.**

Publications in the subject matter

KIRÁLY K. (2005): Improvement in intensity of cherry production using phytotechnical methods. 5th International Cherry Symposium. 6-10 June 2005. Bursa-Turkey. Abstracts, 143.

KIRÁLY K. (2005): Meggyfajták koronaméretének, metszési időszakának valamint a gyümölcs minőségének összefüggései. Agrártudományi Közlemények. Debrecen, 16: 90-94.

KIRÁLY K. - GONDA I. (2003): Csonthéjasok fagykárosodása a 2002/03 években a Debrecen-Pallag Kísérleti Telepen. „Lippay János-Ormos Imre-Vas Károly" Tudományos Ülésszak. Budapest, 330-331.

KIRÁLY K. - GONDA I. (2004): Cseresznyefajták növekedési tulajdonságainak összehasonlító vizsgálata. Innováció, a tudomány és a gyakorlat egysége az ezredforduló agráriumában. Debrecen, 78-79.

KIRÁLY K. - GONDA I. (2004): A fajta szerepe és jelentősége a cseresznye intenzív termesztéstechnológiájában. Agrártudományi Közlemények. Debrecen, 81-84.

KIRÁLY K. - GONDA I. - HOLB I. (2005): Cseresznyefajták vegetatív és generatív tulajdonságainak összehasonlító vizsgálata. Kertgazdaság, 37(1):33-44.

KIRÁLY K. - SZENTPÉTERI T. (2005): Cseresznyefajták növekedése és a kórokozókkal szembeni fogékonyság összefüggéseinek vizsgálata. Erdei Ferenc III. Tudományos Konferencia. Kecskemét, 626-630.

KIRÁLY K. - SZENTPÉTERI T. (2005): *Blumeriella jaapii* (Rehm) v. (Arx) infection of some sweet cherry cultivars in two years with different precipitation conditions. International Journal of Horticultural Science, Agroinform Publishing House, Budapest, 2006, 12(3): 59-61.

GONDA I. - **KIRÁLY K. -** HOLB I. J. (2004): Comparative examination of cherry varieties adopted to intensive production. 8th International Symposium on integrating canopy, rootstock and environmental physiology in orchard systems. 13-18 June 2004. Budapest, Programme and Book of Abstracts, 83.

GONDA I. - **KIRÁLY K**. (2005): A nyári metszés hatása a meggyfajták növekedésére és gyümölcsminőségére. Kertgazdaság, 37(1): 45-52.

SZABÓ, Z. - NYÉKI, J. - DANI, M. - DRÉN, G. - THURZÓ, S. - TORNYAI, J. - RACSKÓ, J. - LAKATOS, L. - GONDA, I. - SOLTÉSZ, M. - **KIRÁLY, K.** - SZALAY, L. - SZÉL, I. (2005): A 2005. januári és februári hőmérsékletingadozás hatása a csonthéjasok virágrügyeire. "AGRO-21" Füzetek, Klímaváltozás-Hatások-Válaszok. (45): 159-171.

SZENTPÉTERI T. - **KIRÁLY K.** (2005): Adatok cseresznyefajták Blumeriella jaapii /REHM/ v. /ARX/ fertőzöttségéről. 10. Tiszántúli Növényvédelmi Fórum. 331-337.

THURZÓ, S. - HERMÁN, R. - DRÉN, G. - SZABÓ, Z. - RACSKÓ, J. - DANI, M. - SOLTÉSZ, M. - **KIRÁLY, K**. - NYÉKI, J. (2005): Cseresznyefajták fagytűrőképessége. Kertgazdaság, 37(4): 23-29.

THURZÓ, S. - SZABÓ, Z. - VERES, ZS. - **KIRÁLY, K.** (2005): V. Nemzetközi Cseresznye és Meggy Szimpózium. Kertészet és Szőlészet, 2005/31. 10-11.