CERTAIN TECHNOLOGICAL ELEMENTS AND ECONOMIC RELATIONSHIPS OF GREENHOUSE PEPPER PRODUCTION ON ROCKWOOL

Doctoral Theses

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Research Background and Objectives

Of the greenhouse crops in Hungary the most important is the pepper (Capsicum) which accounts for 50% of total production value. Nowadays, greenhouse pepper is grown on an area of approximately 2,000-2,500 hectares of which rockwool media is estimated to range between 2,000 and 2,500 hectares. As it is labour intensive, production is mostly carried out by small enterprises and family farms, the majority of which range between 1,000 and 3000 sq meter in size, though some agricultural enterprises (e.g. the companies Szentesi Árpád Agrár Rt. and Flóratom Kft.) have much bigger areas under greenhouse pepper.

Pepper consumption is growing rapidly in the European Union and this tendency is not likely to change in the coming years. Hungary has only a small share of production. Among the member states, the Netherlands and Spain are net exporters, i.e. their pepper exports exceed imports. The appearance of globalization and the new consumption habits have boosted demand for such products as white fruited pepper that formerly were only available on the East European markets. It is also of great significance that vegetable production is not subject to quotas in the European Union, therefore the white fruited pepper can have an ever bigger role in the exports with its 'Hungaricum' character distinctive appearance and quality.

The structure of production will also undergo changes. As a result of high heating costs, very early and early production systems will be less common or will remain in use only by the bigger growers that have already established their business (e.g. the company Árpád Agrár Rt.). It will be possible to sustain a high level of heating mainly where it will also be possible to make use of cheaper natural energy sources (e.g. thermal water). Soil-based production is also likely to diminish in importance, chiefly due to the ever greater extent of soil infection and the resulting yield losses and this way the area of rockwool media will grow in percentage. The new techniques and the strengthening of competition will bring new tasks for growers. They will have to take decisions with long term consequences for production.

The grower must consider what kind of growing conditions (heating level) can be provided for the production of the white fruited pepper varieties as well as which varieties can be grown profitably in his particular situation. He must find the point where the plant produces the highest yields and best quality, at the same time, he must also pay due consideration to the increase in the accompanying costs and labour requirement. Pruning is one of these issues. The different pruning techniques involve different costs and they require higher skills than the traditional methods and according to some researchers may even reduce earliness. This, on the

other hand, is compensated by the decrease in the required number of transplants due to greater plant spacing which decrease can be as much as 1 or 2 transplants per square meter.

So far, greenhouse pepper growers (considering trained and pruned plants) have been producing pepper on rockwool relying only on their experiences and on the results of soil based cultivation, without systematic pruning trials. Owing to obtaining satisfactory yields they did not consider it necessary to carry out experiment to verify and to try to find the most suitable variety and the best pruning method for the variety. The books and the various publications, as well as the conferences organized on this subject, describe and propagate principally fertigation and pruning practices adopted from the Netherlands.

The main objective of my thesis is therefore to find the optimal pruning method for the white fruited varieties commonly used in rockwool cultivation which permits the most successful production of the given variety.

- In this framework, to elaborate the method for the examination of the pepper varieties suitable for rockwool pepper cultivation.
- With the help of performance trials, to evaluate the white fruited hybrid pepper varieties of different characteristics in rockwool cultivation during the given period.
- To carry out analysis of the results, from year to year, also in economic terms in order to be able to determine the most effective pruning method for each variety.
- Based on the results, to work out recommendations for growers relative to the varieties.

Material and Method

The experiments were performed in 2002, in 2003 and in 2004 at the Experimental Farm of the Faculty of Horticulture of the Corvinus University of Budapest, formerly of Szent István University, in Soroksár. Plants were planted out on rockwool slabs in one of the spans of a new multi-span FILCLAIR greenhouse of 1500 sq m. The structure was 52 m long and 9.6 m wide with a gutter height of 3.75 m.

The greenhouse frames were covered by two layers of plastic films inflated by the pressure of the air. The constant air pressure is provided by a blower therefore the greenhouse is well insulated so that the plants in it will not be frost-bitten even at an outdoor temperature of minus 7°C. The ventilation is controlled by an automatic system set for any desired temperature which opens or closes the vents.

Prior to the trials, the ground of the greenhouse had been arranged in a manner to be suitable for rockwool cultivation. The area, which was completely free of weeds, was made even and than compacted by means of a heavy roller. The surface was made to slope uniformly and furrows were made between the twin rows to be formed subsequently to provide for the runoff of excess nutrient solution. After that a white plastic film was placed over the surface and the growing slabs (200×15×7.5 cm) were also arranged and the dripper system was assembled. The trellis system was also assembled which had a height of 2.50 m.

The heating system of the greenhouse was under continuous development in the period 2002-2003, therefore I was able to carry out experiments only under conditions of ‘emergency heating’ (Δt 5°C). Finally in 2004 I managed to set up the experiment already with moderate heating (Δt 15°C).

For the purpose of the experiments, as test plants, I chose stuffing type (white fruited) indeterminate hybrid varieties which are widely used in production in Hungary and can also be competitive with foreign varieties. Only the varieties HRF, which can be regarded as a control variety, and Hó, which is the most widely used variety in rockwool cultivation, were studied in all three years. The other varieties were chosen from the cultivar assortment recommended for the given rockwool and already proven successful. This way the test material in 2002 included the Bajnok, in 2003 the Danubia and in 2004 the Century.

After determining the number of the seedlings required, sowing was carried out on March 5th in 2002, on March 4th in 2003 and on February 2nd in 2004. In all three years, 16-25 days after pricking out, the plants were transferred into the Filclair greenhouse and there they

were spaced apart to a density of 25 plants per square meter because plant leaves were already touching.

Each year I started the out-planting depending on seedling development and on weather conditions. The slabs were filled with nutrient solution prior to planting (Table 1).

Table 1: Sowing, pricking and planting dates in the 2002-2004 experimental period (Soroksár).

Experimental year	2002	2003	2004
Sowing	March 5th	March 4th	Feb 2nd
Pricking	March 21st	March 21st	Feb 19th
Spacing apart	Apr 5th	Apr 10th	March 8th
Planting	Apr 18th	Apr 28th	March 17th

The experiments were conducted to investigate how the two factors, the pruning method and the variety, affected yields and quality of different white fruited Hungarian pepper varieties.

Three pruning techniques were carried out at three plant spacings and four repetitions were used in 2003 and in 2004. In 2002 it was not possible to have repetitions. In the first treatment the plants were pruned to a single stem, in the second they were trained to two stems and in the third to three stems. Depending on the level of pruning, the plants were planted at different spacings (Table 2).

Table 2: Arrangement of the plants in the trial (2002-2004 Soroksár).

Pruning method	Stems/ m^2	Plant density (plants /m^2)	Intra and inter row spacings (cm)	Plants/slab (2m long)	Plants/repeat
One stem	5.7	5.7	80+60×25	8	24
Two stems	8.6	4.3	80+60×33	6	18
Three stems	10.8	3.6	80+60×40	5	15

Pepper plants were planted on 2 meter long slabs. The plants were set in twin rows in conformity with those described in the Table. This way, depending on the type of pruning, 8, 6 and 5 plants were set per square meter. 228 plants of each variety were planted equivalent, depending on the type of pruning, to 24, 18 and 15 plants per repeat which corresponded to a 3 meter long twin row section.

Pruning

One stem system

After that the plants had been planted out, when the first branchings appeared and the shoots could already be seized (3-4 cm long) I selected a shoot (leader) and trained it to climb up along the string. At the first branching of the lateral shoots I broke off the stronger shoot and left the lateral shoot grow. Whenever they grew too long I broke them at 15-20 cm.

I repeated the same operation with every lateral shoot later on. In the end, I removed the spent lateral shoots. The short 'fruiting shoots' were left untouched.

Two stem system

When pruning to shape the plants, two shoots (later leaders) were left at the first fork. The other lateral shoots were removed.

Afterwards, the short fruiting shoots were left and the lateral shoots were treated in accordance with the condition of the plants. If plant growth was weak they were entirely removed, while in the case of stronger plants after two nodes the stronger shoot was removed. Then when the lateral shoot had finished fruiting it became wholly removed.

Three stem system

After planting out the plants were pruned depending on the number of branchings. In the case of three branchings, I left all three shoots and the final shoot system was formed by them. In the case of two branchings, I selected the third leader shoot from the second branching level.

In this case, the method described for the single and two stem technique is not valid, i.e. all side shoots should be removed completely otherwise, if left to remain, they would make the plants grow to a tangled and unmanageable mass. The short fruiting shouts should be left intact.

Pickings and measurements were usually started during the morning hours. Fruits were collected in plastic buckets then stored in labelled plastic bags until measuring. After finishing picking I started measuring the very same day.

In the experiments I measured the total fruit yield, as well as the weight of the different classes after grading. Grading was carried out according to the standard also used in commerce. The fruits were sorted into 4 grades: extra class, 1^{st} class, 2^{nd} class and substandard (sunburned and deformed fruits, undersized fruits).

In the evaluation process yields were expressed per square meter and average yields were calculated from fruit yields. Besides, I attached great importance to using indicators expressed per plant, too, since the true performance of plants can only be estimated by means of such indicators.

Data were analysed with the two-way analysis of variance using the programme Statistica 6.0 at 95% confidence level, as well as using the Tukey HSD test to make comparisons between pairs. Due to the relatively low number of repeats (4) in some cases it was not possible to detect significant difference though the difference was evident based on what had been observed when growing the plants.

In the case of the varieties tested, it is not sufficient to determine which pruning method will help to achieve the highest average yields. It is necessary to confirm the results with profitability analysis, since it is not guaranteed that the treatment which gives the highest yield average will also be the most efficient growing method.

In my work I retained it necessary to make use not only of literature references but also the information, the data and practical experiences collected at the growers in order to get an image as accurate as possible for the economical analysis. Besides, for the calculations I also utilized the data from my pepper growing trials on rockwool carried out at the experimental station of the Department of Vegetable and Mushroom Growing. In the arranging and processing of the data I relied on the directions of the Department of Management and Marketing.

To model the farm, for the basis I took a modern, newly constructed plastic block of 3,500 m2, equipped also with automatic ventilation and of double plastic cover where the jobs were carried out by the two adults of a four member family and by three physical workers.

The amortization costs were calculated according to the amortization calculation method of equal annual portions, without interests. This means that the value of the implement or machine every year decreases at the same percentage of the gross value of the implement.

Based on the data from the model farm and on the average yields obtained for the individual varieties and pruning methods, I calculated the costs and total sales per square meter. In making the calculations, with the different varieties and treatments I paid due consideration both to the distribution of fruit yield over time and the fruit quality distribution at each picking. In the case of each picking I calculated with the current market price. This way, considering the fruit yields per unit area and based on the gross income it was easier to decide which pruning method to recommend for the given variety.

Results and discussion

HRF

The variety HRF, as a 'traditional' variety, was included in the material of the experiment to be the control. In my investigations I concluded that the one stem technique and the two stem technique showed better results compared to the three stem treatment in the rockwool technique in terms of yields per square meter. With the two pruning methods I measured an average yield of 17.50 and 17.30 kg/m^2 in 2002, 16.84 and 17.06 kg/m^2 in 2003 and 18.03 and 18.10 kg/m^2 in 2004.

Considering earliness, the one stem system turned out to be the best in each of the years. Considering the single plant indicators I found a clear relationship. In all three years the increase in the number of fruiting stems was accompanied by the increase in the number and weight of fruits that could be harvested from a single plant.

Based on the results of the three years it can be concluded that the number of the fruiting stems had no statistically demonstrable influence on the average fruit weight; in the case of the three stem system I obtained, even if to a lesser degree, lower values in two years.

In terms of the qualitative distribution of the fruits, similarly, the best results were obtained by using the one stem and two stem systems, though this was not confirmed by the statistical analyses.

In the first two years with unheated conditions, the highest weights and fruit numbers were obtained at the second or the third harvests in the case of the tested variety when using the one stem and the two stem systems. In response to the three stem system, as a result of the slow development of the fruiting surface, I managed to measure higher average yields only at the later harvests. In the third year the yielding pattern of the variety was completely different in middle early greenhouse production. In the early period the increase of the number of fruiting stems was clearly accompanied by a decrease of the number of fruits picked. As considers the yielding pattern, all three treatments could be described with the same trend.

Based on all the indicators tested and the economical analyses, in the case of the variety HRF, I have concluded that the two stem system, requiring a lower number of plants per square meter and less investment, is recommended for use on rockwool in every period of greenhouse production, due to economic considerations. The relatively higher costs of the one stem system are not counterbalanced by the high sales incomes from the great number of high quality early

fruits. When producing the variety in long culture, again, the two stem system, started with a lower number of plants per square meter, can be used.

In view of what has been said above it can be concluded that the variety is less suitable for being grown on rockwool due to its limited excellence (yield potential).

Bajnok

The variety was granted registration in 2001 and showed some very promising results when grown on soil, therefore I tested it on rockwool, too. In terms of yields per square meter, the highest values were obtained with the two stem system (19.78 kg/m^2).

Considering earliness, in 2002 the highest results were obtained for the two stem system. The total fruit number per square meter of the first two pickings was 25% higher than the one stem system having the second greatest value. I did not observe the earliness enhancing effect, encountered in the practice, with the one stem system.

Considering the single plant indicators, I found a clear relationship also in this variety. The lowest number of fruits per plant was yielded by the one stem system, while the highest number of fruits was picked from the plants with three stems.

Based on the data of the year 2002, I measured the highest average fruit weight with the one stem technique (100.3 g), while the lowest one with the three stem technique (96.4 g).

Considering the fruit quality distribution, the best results again were obtained with the two stem system. The proportion of the Extra and 1^{st} class fruits in this variety, on the whole, was the highest with this treatment reaching 57%.

The yielding pattern can be described with the same trend in the case of each pruning method. It is characterised by a very important phenomenon, i.e. sharply increasing and high yields, and as a result, part of the fruits can be sold at a high price.

Based on those described above and the economical analyses, I have concluded that the two stem system, requiring a lower number of number of plants per square meter and less investment, is recommended for use in every period of greenhouse production, due to economic considerations.

The variety has good genetic potentials and is characterised by high average yields and good quality. The purplish discoloration, as observed on the fruits in certain periods, is however considerably deteriorates the opinion about the variety. Due to the aesthetic defects, it is less suitable for production on rockwool.

Danubia

Considering most of the indicators, the performance of the variety was lower as compared to the other varieties. In both years the highest yield was harvested from the plants trained to two stems. (17.06 kg/m^2; 17.20 kg/m^2). This observation applies also to early fruits.

Considering the single plant indicators, I found the same relationship in this variety as in the former ones. It was the single stem technique that produced the lowest number of fruits per plant, while the highest number of fruits were picked from the plants with three stems.

The variety Danubia was inferior to the other varieties also with regard to the fruit quality distribution. The proportion of the extra and 1st class fruits was the lowest, not reaching the level of 40% in either of the years, while considering the second class fruits, I measured the highest values (51.91-55.75 %). The proportion of the substandard fruits was acceptable, but it is worth to note that the majority were healthy but too small.

The yielding pattern of the tested variety could be described with the same tendency in both years and in all three pruning methods. By the end of the growing season the plants tended to bear fruits increased in number but smaller in size.

Based on the data obtained and the economical analyses, I consider the two stem system to be the most efficient for use in every period of greenhouse production.

Based on the results and on my experiences I do not recommend it for production on rockwool in greenhouse.

Kaméleon

The variety Kaméleon, due to its light green colour, was included in the trial as a variety intended to broaden the assortment. In my trials, considering the yields per square meter, I did not manage to reveal any difference between the pruning methods in the year 2003 (19.68 kg/m^2; 19.47 kg/m^2; 19.67 kg/m^2).

In the year 2004, on the other hand, it was the one stem system that proved the best (22.86 kg/m^2).

Relative to earliness, the one stem system produced the best results both in the year 2003 and 2004. With the one stem system the earliness enhancing effect encountered in the practice was well visible in both years.

Considering the single plant indicators I found a clear relationship in this variety, too. It was again the single stem technique that produced the lowest number of fruits per plant, while the highest number of fruits were picked from the plants with three stems.

Based on the results obtained, it can be seen that the highest average fruit weight was measured for the one stem technique (98.2 g), while the lowest one for the three stem technique (93.8 g).

Considering the fruit quality distribution, the proportion of the Extra and 1st class fruits was very high which was substantially free from any influence from the number of the fruiting stems. This high value can also be said to be true to the proportion of substandard fruits. The main reason was that the fruits were susceptible to sunburn.

The yielding pattern of the tested variety is characterised by an exceptionally high early fruit number of the one stem system in the early period and as a result part of the yield can be sold at a high price. Later the yielding pattern was characterised by a higher number of harvested fruits in the autumn season in response to the two and three stem systems than in the one stem system.

Based on those described above and the economical analyses, I have concluded that for the variety Kaméleon the one stem system is recommended for use in early greenhouse production, but later the two and three stem systems. In view of the controversial data of the two years, on the other hand, further investigations are considered necessary.

Century

In terms of yields per square meter the variety is characterised by evenness. The pruning methods did not have any influence on the yields per square meter. I registered values of over 20 kg/m^2 in each case (20.66 kg/m^2; 20.91 kg/m^2; 20.99 kg/m^2).

Considering earliness, the one stem system produced the highest results (13.04 kg/m^2). Based on the results it can be seen that the pruning methods had strong influence on the number of early fruits. The more main stems are left, the lower is the proportion of the early fruits.

Considering the single plant indicators, it was the single stem system that produced the lowest number of fruits per plant, while the highest number of fruits were picked from the plants with three stems, which corresponds to the tendency described for the other varieties.

The number of the fruiting stems had no influence on the average fruit weight (97-98 g) and it follows that it is not necessary to be considered in the selection of the technique to be applied during production.

The evenness of the variety is also indicated by the percentages obtained for the distribution of fruit quality. The summed proportion of the extra and 1st quality fruits was over 60% in all three pruning methods.

The yielding pattern the tested variety could be described with the same trend for each pruning method. The superior yield observed for the one stem system was counterbalanced by the autumn harvests of the other two systems. The principal reason is the protracted development of the fruiting system seem in the two and three stem systems.

Due to the evenness of the variety Century and to economic considerations the three stem system, requiring the lowest investment per square meter, is recommended for use in every period of greenhouse cultivation. As a result of the high grade of virus resistance of the variety, it is also unnecessary to be anxious about considerable yield diminishing effect of dead plants in the case of this technique.

The variety has excellent genetic properties. Besides high average yields, it is characterised by high quality and at the same time one should not forget about its resistance to tobacco mosaic virus which is unique in Hungary. In view of those described, I strongly recommend it for greenhouse production on rockwool, proposing further investigations.

Hó

In my investigations I concluded that the two stem system produced the highest results in terms of yields per square meter (20.72-23.12 kg/m^2) when using the rockwool technique with the variety Hó.

Considering the single plant indicators, I found the same relationship. It was the single stem technique that produced the lowest number of fruits per plant, while the highest number of fruits were picked from the plants with three stems.

The variety Hó performed very well also relative to the qualitative distribution of the fruits. The proportion of the extra and 1st class fruits was high in each year, over 60%, while as to the second class fruits, it was around 25-35%.

The yielding pattern is characterised in each pruning method by the same tendency: high early yields and even fruit size. In the summer period, on the other hand, the variety tends to yield unevenly which is principally due to its high susceptibility.

Based on the results, in the case of this variety, too, I recommend the two stem system for use on rockwool in every period of greenhouse production.

The variety has very favourable genetic properties and its is characterised by very high average yields and by excellent quality. Out of the varieties tested, it is the one that most sensitive to growing conditions, therefore it can be grown with success only at a proper technological level (e.g. controlled climate) and with proper expertise. Among the deficiencies, one could mention its week virus resistance. It is presently the number one white fleshed pepper variety in rockwool production in Hungary.

New scientific results and recommendations for practical application

Based on the investigations carried out in the years between 2002 and 2005 I have come to the following important scientific conclusions (Point 1) and results that are useful for the practice (Point 2):

1. I have elaborated an investigation method for the pruning methods of white fleshed pepper varieties suitable for production on rockwool.

   1.1. In the course of the pruning experiments I have concluded that

      1.1.1 The pruning method applied had a considerable influence on the average yields per unit area on rockwool. This is one of the most important points. On the other hand, it is not possible to elaborate an unequivocal recommendation or rule that applies to every variety and to all growing conditions. Every variety should be tested individually in every case.

      1.1.2 Considering the indicators of the single plant, I obtained the same relationship in each case. It was the single stem technique that produced the lowest number of fruits per plant, while the highest number of fruits were picked from the plants with three stems.

      1.1.3 Based on the data of the three years it can be seen that the number of the fruiting stems had no significant influence on the average fruit weight and it follows that it is not necessary to consider it in the selection of the technique to be applied during production.

      1.1.4 Considering the number of the early fruits it can be observed that there was little evidence of the higher number of early fruits, encountered in the practice, with the one stem system under unheated greenhouse conditions. Under poorer light conditions, however, a clear tendency was observable between the number of the early fruits and the pruning method at the earlier planting date (2004). The highest yields are obtained from the one stem plants, while the lowest yields from the three stem plants. This initial yield loss, on the other hand, is frequently successfully compensated later by the fruiting surface consisting of more stems, slower to develop but bigger in size.

      1.1.5 The pruning method has very little influence on the quality of the fruits. I obtained similar results for the one stem and the two stem systems with each variety. Usually, the three stem plants, though to a lesser degree, had poorer fruit

quality. Therefore, it is not an important point in the selection of the pruning method.

2. Based on performance tests and economical analyses I have evaluated 6 white fleshed pepper varieties having different properties in rockwool production. I made recommendations relative to the varieties. Each year I carried out economical analyses in order to be able to select the most efficient pruning method. I advise to carry out such calculations for every variety and technique, because this is the most important point which is the basis of the grower's decision on the variety or technique.
   2.1. I regard the variety Hó to be the most suitable for production on rockwool with the two stem system.
   2.2. Besides Hó, the variety Century can be a good choice. With its high Tm3 resistance it can be grown safely under greenhouse conditions. It can be grown successfully also with the three stem system involving lower costs.
   2.3. The variety Kaméleon, as a variety enlarging the assortment, has excellent characteristics. Based on the trials, both the one stem and the three stem system could be suitable in production. To decide this issue further investigations are necessary.
   2.4. I do not recommend the varieties Danubia and HRF for production on rockwool due to the low average yields, nor the variety Bajnok because of the frequent discolouring of the surface of the fruits.

3. Based on the investigations and results, in the end, I suggest that similar trials and calculations should be carried out in the case of every variety or candidate variety intended to be introduced.

Publications on the theme of the thesis

Reviewed articles in papers:

1. **Tompos D**., Gyúrós J. (2002): Termesztéstechnológiai tényezők összefüggése a Kárpia F1 paprikafajta hajtatása során. Kertgazdaság. 34(2) p.79-82.
2. **Tompos D**. (2003): Különböző metszési technikák alkalmazásának hatása egyes magyarországi paprikafajták termésére. Kertgazdaság. 4(35) p.28-36.
3. **Tompos D.** (2004): A termésmennyiség és terméminőség javításának lehetőségei kőzetgyapotos paprikatermesztésben. Kertgazdaság, 36(1) p.3-6.
4. **Tompos D**. (2004) A paprika kőzetgyapotos hajtatásának jövedelmezősége családi gazdaságokban. Kertgazdaság. 36(3) p.73-76.
5. **Tompos D**., ifj. Gyúrós J. (2004): Comparison of light yellow fleshed pepper varieties grown on rockwool under unheated forcing circumstances. International journal of Horticultural science. 10(1) p.107-111.
6. **Tompos D**., Gyúrós J. (2005) A kőzetgyapotos paprikahajtatás dinamikus gazdasági elemzése. Kertgazdaság, 37(4) p.62-69.

Other relevant articles:

1. **Tompos, D**., Gyúrós, J. (2002): A Kárpia F_1 paprikafajta hajtatása és metszése. Hajtatás korai termesztés. 33(2) p.6-9.

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1. **Tompos D**., ifj. Gyúrós J., Kocsis I. (2003): Fehérhúsú paprikafajták összehasonlítása kőzetgyapoton. A Szegedi Akadémiai Bizottság Mezőgazdasági Szakbizottságának tudományos ülése, Integrált Kertészeti Termesztés, Tessedik Sámuel Főiskola, Szarvas, 2003. október 17. p.119-125.
2. **Tompos D**., Gyúrós J. (2004): A tápanyagutánpótlás javításának lehetőségei kőzetgyapotos paprikatermesztésben. Integrált termesztés a kertészeti és szántóföldi kultúrákban XXV. Budapest, 2004. p.104-110.
3. Slezák K., **Tompos D**. (2004): Égetett agyaggranulátum, mint a vízkultúrás paprikatermesztés újrahasznosítható közege. Proceedings of The 11th Symposium on Analytical and Enviromental Problems, 27 September 2004, SZAB Szeged, Hungary. p.75-79.

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1. **Tompos D**. (2003): A tenyészterület és a metszésmód hatása az étkezési paprika termésére. XXVI. Országos Tudományos Diákköri Konferencia Agrártudományi Szekció, Kaposvár, 2003. p.102-104.
2. **Tompos D**. (2005): A paprika kőzetgyapotos hajtatásának dinamikus gazdasági elemzése. Lyppai János-Ormos Imre-Vas Károly Tudományos Ülésszak.. Összefoglalók, Kertészettudomány. 2005. október 19-21, Budapest. p.366-367.

International conferences (in English, full paper):

1. **Tompos D**., Gyúrós J. (2003): The pruning techniques of different Hungarian pepper varieties. Universitatea de Stiinte Agricole si Medicina Veterinara a Banatului Timisoara Cercetari Stiintifice Horticultura, 2003. p.7-14.

International conferences (in English, abstract):

1. **Tompos D**. (2003): Different pruning techniques on Hungarian pepper varieties grown on rockwool. The International Fertiliser Society The 2003 Dahlia Greidinger Symposium, 'Nutrient, Substrate and Water Management in protected Cropping Systems Proceedings: Invited papers, offered posters and list of delegates, Izmir, 7-10 December 2003. p.390-393.
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