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Situation of peach resistance to diseases in Romania

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Summary: The resistance of peach cultivars to the most important diseases caused by fungi, bacteria, viruses and mycoplasms was studied in Romania over two working stages in the period between 1985–2005. The major diseases examined were: *Cytospora cincta Sacc., Taphrina deformans (Berk) Tul., Monilinia laxa* (Aderh. & Ruhl) Honey, *Sphaerotheca pannosa* var. *persicae* Woron., *Stigmina carpophila* (Lev) M.B.Ellis, *Pseudomonas syringae* pv. *syringae*, mycoplasm and plum pox potyvirus. Based on the obtained results, the studied cultivars were classified into resistance groups for the different diseases (very resistant, resistant, medium resistant, sensitive and very sensitive).Based on the results of our study, the following gene sources were chosen following the evaluation of the various genetic material in the peach germoplasm fund, in the climatic conditions of Romania: *Cytospora cincta*: Cullinan, Cardinal, Hamlet, NJF 3, Onakita Gold, Triumf, "Superba de Toamnă", Anderson, Weinberger; *Stigmina carpophila*: Armgold, ARK 109, Stark Early Blaze, Cardinal, Congres; *Taphrina deformans*: Madeleine Pouyet, Cumberland, Harbelle, Indian Blood, Sulivan, Victoria, Zafrani, Pekin, Naradnji Ranhii; *Spaherotheca pannosa* var. *persicae:* Triumf; Congres; Victoria; Armking; Morton; Regina; Nectared 7; ARK 125; ARK 134; Regina.

Key words: peach, cultivar resistance, disease resistance

Introduction

Plant diseases (caused by fungi, viruses, bacteria) cause significant losses to agriculture and economy by decreasing the yield and quality of crops. Several studies have already proved that cultivar susceptibility has a key role in the effect of plant pathogens on fruit trees, such as in the case of apple scab and powdery mildew on apple (*Jones & Aldwinckle*, 1990, *Holb*, 2000, 2005) or powdery mildew, brown rot and leaf curl on peach and nectarines (*Roselli Bellini*, 1976; *Simeone*, 1987; *Benedek* et al. 1990, 1993; *Ivascu Balan*, 1994; *Ivascu* et al., 1996; *Toma Ivascu*, 1997, *Toma* et al., 1998, 2003; *Holb*, 2003). It is difficult to fight against pathogens and pests in the case of fruit trees unless spending considerable sums on chemical treatments.

Peach and nectarine are affected year after year, by a series of phytopathogen agents like: *Taphrina deformans, Sphaerotheca pannosa, Cytospora cincta, Monilinia laxa, Pseudomonas syringae, Plum Pox Potyvirus*, as well as *Phytoplasmas.* The control of these agents requires significant material expenses for the application of 13–15 treatments. These treatments, along with the good effect that is saving the crop have an entire series of disadvantages like: environmental pollution, toxic waste in the fruits, production expenses increase etc. Of these aspects, the introduction of cultivars resistant to diseases is to partially or totally diminish the said negative aspects (*Benedek* et al., 1993; *Kervella* et al., 1998).

Creating and using resistant varieties in plant cultures is one of the most effective ways to reduce the number of treatments and to decrease pollution (*Benedek* et al., 1993; *Kervella* et al., 1998). The new peach cultivars (Triumph, Congress, Victoria, Alexia, Antonia, Dida, Eugen) or nectarine cultivars (Mihaela, Tina) obtained at SCDP Baneasa with increased resistance against diseases are not inferior as regarding quality or production potential to classic cultivars; further more, they have the advantage of a simplified technology leading to a significantly lower cost due to the reduced number of chemical treatments.

The peach improvement program implemented in Romania to grow the disease resistance has not led so far to spectacular results, respectively to totally resistant cultivars, able to replace the sensitive ones, but to cultivars with increased resistance to certain diseases.

This paper presents the collection and analysis of results obtained over two working stages between 1985–2005, respectively the study of the peach and nectarine cultivars behavior as to the attack of various pathogen agents; the research was carried out together with the Research Institute for Plant Protection.

Materials and methods

The observations and notes concerning the main peach and nectarine diseases were made on experimental land parcels at Research Station for Fruit Tree Growing Baneasa, Bucharest, while applying pesticide treatments as response to warnings. The treatments applied in the last 3 years of the experiment are shown in *Table 1*. The observed differences were due exclusively to the cultivars and their reaction to pathogen agents. 250 phenotypes coming from 4 different geographical areas (Europe, Asia, North and South America) have been observed.

It can be noticed that the number of classic treatments used on peach culture was reduced from 12 to 8, sustaining the effort to reduce the expenses for pesticide products and also to protect the environment and consumers.

Table 1 Treatment scheme in the last 3 years of the experiment

No	*Stage*	*Product*	*Dosage*
1	Rest period (end of January, February)	US1	1.5%
2	March	Alcupral	0.2%–0.4%
3	Before blossom	Bravo or Merpan+ Fastac or Carbendazim	1.5% 0.25%+0.03% 0.1%
4	May	Alcupral or Bravo+Calipso or Dithane M-45	0.2% 0.15%+0.02% 0.2%
5	Fruit with 15 mm	Merpan+Reldan or Systane+Talstar or Bravo+Reldan	0.15%+0.1% 0.1%+0.04% 0.15%+0.15%
6	Ripening	Mancozeb+ Fastac or Topsin+Fury or Bravo+Diazol	0.2%+0.02% 0.07%+0.01% 0.15%+0.2%
7	After yielding	Topsin+Reldan or Topsin+Actelic	0.07%+0.1% 0.07%+0.02%
8	Leafless	Alcupral	0.2%–0.3%

Mycosis

For finding the mycosis attacks in the orchards on treatment base, assessment were made for *Cytospora cincta Sacc.* (the percentage of affected branches for each tree has been observed and noted and then it was averaged for tree and variety), and for *Taphrina deformans, Monilinia laxa* and *Sphaerotheca pannosa* var. *persicae.* The following notations were made: F%, I%, GA% for 100, for each tree and then it was averaged for tree and variety.

The following grading system has been used between 0–6:

0 – No attack
1 – The attack is less than 3% of the surface of the observed organ
2 – Attack between 5 and 10% of the surface of the observed organ
3 – Attack between 11 and 25% of the surface of the observed organ
4 – Attack between 26 and 50% of the surface of the observed organ
5 – Attack between 51 and 75% of the surface of the observed organ
6 – Attack between 75 and 100% of the surface of the observed organ

$GA\% = (F \times I) / 100$

For a rapid testing of the material resistance against mildew the roundels method was also used.

For determining peach and nectarine resistance to *Stigmina carpophila, Cytospora cincta, Monilinia laxa,* artificial inoculations were carried out on detached sprigs, in laboratory conditions. After analyzing the length of the lesion caused by the fungus the following classification was made:

0 – 3 mm very resistant variety (FR);
4 – 10 mm resistant variety (R);
11 – 25 mm medium resistant variety (MR);
26 – 50 mm sensitive variety (S);
>51 mm very sensitive variety (FS);

For the selection of the possible genitors resistant to *Monilinia laxa*, laboratory inoculations were carried out, the readings being made after 3 days observing the attack – the area of the lesion in sq cm, and were marked with:

+++ the sensitive varities;
+ the tolerant varieties;
0 the resistant varieties;

Mycoplasms

In order to determine the occurrence of mycoplasm diseases, we used the optical microscopy technique after staining sections with Dienes dye. We took 3 samples from each tree consisting of annual shoots.

We made fine sections starting with the basis of the shoot by using a blade or scalpel. The slices placed on the microscope blade were covered with Dienes solution and left for 1–5 minutes, then the dye was absorbed with a pipette and the slices washed several times with distilled water applied also with a pipette.

We poured a drop of distilled water over the slices thus treated, put the blade and examined it with the microscope. Based on the colour of the woody vessels, the trees were marked negative (no mycoplasm present) or positive when the vessels were coloured (that is the pathogen agent was present).

Bacterioses

The peach and nectarine biological material was tested also for the resistance against the pathogen bacteria *Pseudomonas syringae* pv. *syringae*. Ten annual shoots were cultured from each genetic form, then pruned to 20 cm, paraphined on the upper part, disinfected with 0.5% hypochlorite during 3 minutes and washed twice with sterile water. The inoculation was made with *Pseudomonas syringae* pv. *syringae* bacterial suspension, a mixture of 3 stems: T 15947 that produces syringomicine, T 1438 with strong ice nucleating activity and T 1428 that moderately produces syringomicine and has moderate ice nucleating activity, with a 10^8 UFC titre. The infections were performed by means of two incisions on each shoot, with a 10 mm cutter loaded with bacterial inoculant. A witness sample was taken out of each genetic form (cultivar) consisting of 2 branches inoculated with sterile water according to the same method.

After inoculation the shoots were introduced in large sterilized test tubes with a wad impregnated in sterile water at their bottoms. The test tubes were covered with paper hoods and were held for 10 days at a temperature of 15 °C, then for 36 hours at –10 °C and finally for 10 days at 15 °C; we observed afterwards the development of injuries (length-mm).

Viruses

Along with the observations made for the revealing of mycoses and bacterioses in natural infection conditions, we followed the occurrence of viroses – Plum pox, well emphasized on some cultivars' fruits. To discover the individuals infected with the Plum pox potyvirus, we performed the ELISA test on each phenotype.

Results and discussion

Based on the examinations, the following classifications have been made *(Tables 2–9):*

Resistant: HNB; ARK 71; Cardinal; Triumf; Superba de Toamnă; HNA; NJN 21; B8R1T4; Cumberland; Harbelle; Indian Blood; Sulivan; Victoria; Zafrani; Pekin; Naradnji Ranhii; Nectared 10.

Medium resistant**:** Crimsongold; Independence; Flavortop; HNC; Sunfree; Early Jersey Queen; Sunglo; Mayred; Morton NJN 58; Pocahontas; Hardyred; Regina Armgold; Stark Early Blaze; Cardinal; Congres; ARK 109; Romamer II; ARK 125; NJN 68; Compact Redhaven; Clayton; Primerose; Maria Bianca; Maria Serena; Admirable; Coronet; Gem Free; Fortuna; Mikado; Independence; Harko; Amalia; Victoria; Armking; Morton; Nectared 7; ARK 134; Flacara; Loadel; Fairhaven; Loring; Harvester; Nectared 10; Fairlane; Capucci 1; Madeleine Pouyet; Early Sungrand; ARK 128; Flavortop; Romamer I; Pocahontas; Magnific 79; Pekin 7–22; Navoi; Suncrest.

Sensitive: Fairlane; Harko; Armking; Weinberger; Primerose; Nectared 4; Jerseyland.

Disease resistance

Disease resistance is one of the main desired features of the peach. The observations concerning resistance were made for *Taphrina deformans, Stigmina carpophila* and *Cytospora cincta.*

Table 2 Resistance of the studied cultivars to *Monilinia laxa*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
	NJN 58; Pocahontas; Hardyred; Regina;	Romamer I; Crimsongold; Romamer II; Independence; Mayred; ARK 125; Nectared 4; Firebrite; Flavortop;	ARK 139; ARK 154; ARK 134; NJN 21;	
Artificial inoculations in laboratory conditions				
	NJN 58; ARK 107;	Romamer I; Crimsongold; Romamer II; Independence; Hardyred; Firebrite; Fantasia;	Pocahontas; Fairlane; Regina; Nectared 7;	Nectared 4

Table 3 Resistance of the studied cultivars to *Stigmina carpophyla*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
	Armgold; Stark Early Blaze; Cardinal; Congres; ARK 109;	Romamer II; Nectared 4; Firebrite; Flavortop; Fairlane; Fantasia; Mayred; ARK 125;	NJ 233; NJ 68; Maygrand 201–16; C2R19T182;	
Artificial inoculations in laboratory conditions				
HNB; ARK 71;	Romamer II; ARK ARK 107; 125; NJN 68; Fairlane;	Romamer I; Crimsongold;	Independence; Mayred; Hardyred; Nectared 7; Pocahontas; Regina; Nectared 7;	Nectared 4

Table 4 Resistance of the studied cultivars to *Cytospora cincta*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
Cardinal; Triumf; Superba de Toamnă; Weinberger;	Armking; Compact Redhaven; Clayton; Hardyred; Primerose; Maria Bianca; Maria Serena; Mayred; Admirable; Coronet; Gem Free; Fortuna; Mikado;	ARK 125; Anderson;	NJN 237; Flavortop; Afterglo; Compact Elberta; Emery; Fairlane; Pocahontas;	
Artificial inoculations in laboratory conditions				
HNA; NJN 21; B8R1T4;	Romamer II; Independence; Regina; Harko;	Crimsongold; NJN 58; Morton;	Nectared 4 Firebrite; Weinberger; Fantasia	

Table 5 Resistance of the studied cultivars to *Sphaerotheca pannosa* var. *persicae*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
	Triumf; Congres; Victoria; Armking; Morton; Regina; Nectared 7; ARK 125; ARK 134; Regina;		Romamer I; Romamer II; NJN 68; Crimsongold; Firebrite; NJN 21;	Jerseyland;

Table 6 Resistance of the studied cultivars to *Taphrina deformans*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
Cumberland; Harbelle; Indian Blood; Sulivan; Victoria; Zafrani; Pekin; Naradnji Ranhii;	Flacara; Loadel; Fairhaven; Loring; Fortuna; Harvester; NJN 58; Hardyred; Regina; Nectared 10; Fairlane; Capucci 1; NJN 85; Madeleine Pouyet; Early Sungrand; ARK 128; A2R41T12;		NJN 67; Fantasia; NJN 237; NJ 253; Flavortop; Nectared 7; Romamer II; Olinda; Okinawa;	

Table 7 Resistance of the studied cultivars to Mycoplasms

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
Mayred; NJN 67; Armking; Nectared 10; Nectared 7;	Flavortop; Romamer I; Pocahontas; Weinberger; ARK 145;		Firebrite; Regina; Harko; ARK 165; Fantasia;	

Table 8 Resistance of the studied cultivars to *Pseudomonas syringae* pv. *syringae*

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
	Crimsongold; Independence; Flavortop; HNC; Sunfree; Early Jersey Queen; Sunglo; Mayred; Morton;	Romamer I; Romamer II; ARK 165; ARK 109; ARK 107; Fantasia; Nectared 7; Peking; Encore; Ellerbe;	Triestina; Harvester; Corell; Afterglo; T2 NJN 237; Nectared 10; Emery; Clayton; Sunfree; Pocahontas; HNB; ARK 125; Hardyred; Firebrite;	Fairlane; Harko; Armking; Weinberger; Primerose;

Table 9 Resistance of the studied cultivars to Plum Pox Potyvirus

Very resistant	Resistant	Medium resistant	Sensitive	Very sensitive
Observations in orchards				
	Magnific 79; Triumf; Pekin 7–22; Navoi; Suncrest; Victoria			

There are few cultivars complying with classes 1 and 2 (very good and good resistance) in the case of *Taphrina deformans*. A few genotypes from France, USA, Canada, Russia and Romania meet the requirements of this group (10% of all genotypes).

Most genotypes (62%) identify with groups 3 and 4 (medium and medium-low resistance). These are genotypes from China, Turkey, Argentina, Greece, England which have a different behaviour compared to their country of origin.

The other 28% of the genotypes are sensitive to *Taphrina deformans* therefore, they cannot be used in the improvement programs relating to this goal (Romamer II, NJ 253, Olinda, Okinawa).

Sources of resistance genes for *Taphrina deformans*: A2R41T12, ARK 128, Capucci 1, NJN 85, Madeleine Pouyet, Early Sungrand.

As sources of genes for resistance to *Stigmina carpophila,* we chose the cultivars from the resistance classes 1–2 (with attack degrees of up to 7%).

These include cultivars from France (12.9%), Italy (15.9%), Canada (18.2%), Romania (19.7%) such as: Armgold, ARK 109, Stark Early Blaze, Cardinal, Congres.

The 5th class (sensitive cultivars) includes genotypes from: USA, Canada, China, Argentina (NJ 233, NJ 68, Maygrand 201–16, C2R19T182).

The climatic conditions in Romania are favourable for the development of *Cytospora cincta*, enabling the selection of resistant genotypes.

Over 25% of the observed genotypes are grouped in the 1st and 2nd classes (very good and good resistance).

We mention here cultivars from France (22.6%), Japan (33.4%), Italy (38.6), USA (52.5%), Romania (52.7%), such as: A15-37, Admirable, Coronet, Chili, Gem Free, Fortuna, Mikado, which will be used as gene sources in hybridising operations.

Considering continents and diseases (*Figure 1*) we notice the following:

The first places in the classification regarding resistance against *Taphrina deformans* are occupied by North America 43.5%, followed by Europe 38.3% and Asia 19.5%.

Concerning resistance against *Cytospora cincta*, the first place is occupied again by North America 49.2%, followed by Europe 44.5% and Asia 10.8% *(Figure 1)*.

As to *Stigmina carpophila* the first place is occupied by Europe 17.8%, followed by Asia 6.5% and North America 5.9% (of all genotypes studied on each continent).

Conclusions

Based on the results of our study, the following gene sources were chosen following the evaluation of the various genetic material in the peach germoplasm fund, in the climatic conditions of Romania: *Cytospora cincta*: Cullinan, Cardinal, Hamlet, NJF 3, Onakita Gold, Triumf, "Superba de Toamnă", Anderson, Weinberger; *Stigmina carpophila*: Armgold, ARK 109, Stark Early Blaze, Cardinal, Congres; *Taphrina deformans*: Madeleine Pouyet, Cumberland, Harbelle, Indian Blood, Sulivan, Victoria, Zafrani, Pekin, Naradnji Ranhii; *Spaherotheca pannosa.var.piersicae:* Triumf; Congres; Victoria; Armking; Morton; Regina; Nectared 7; ARK 125; ARK 134; Regina.

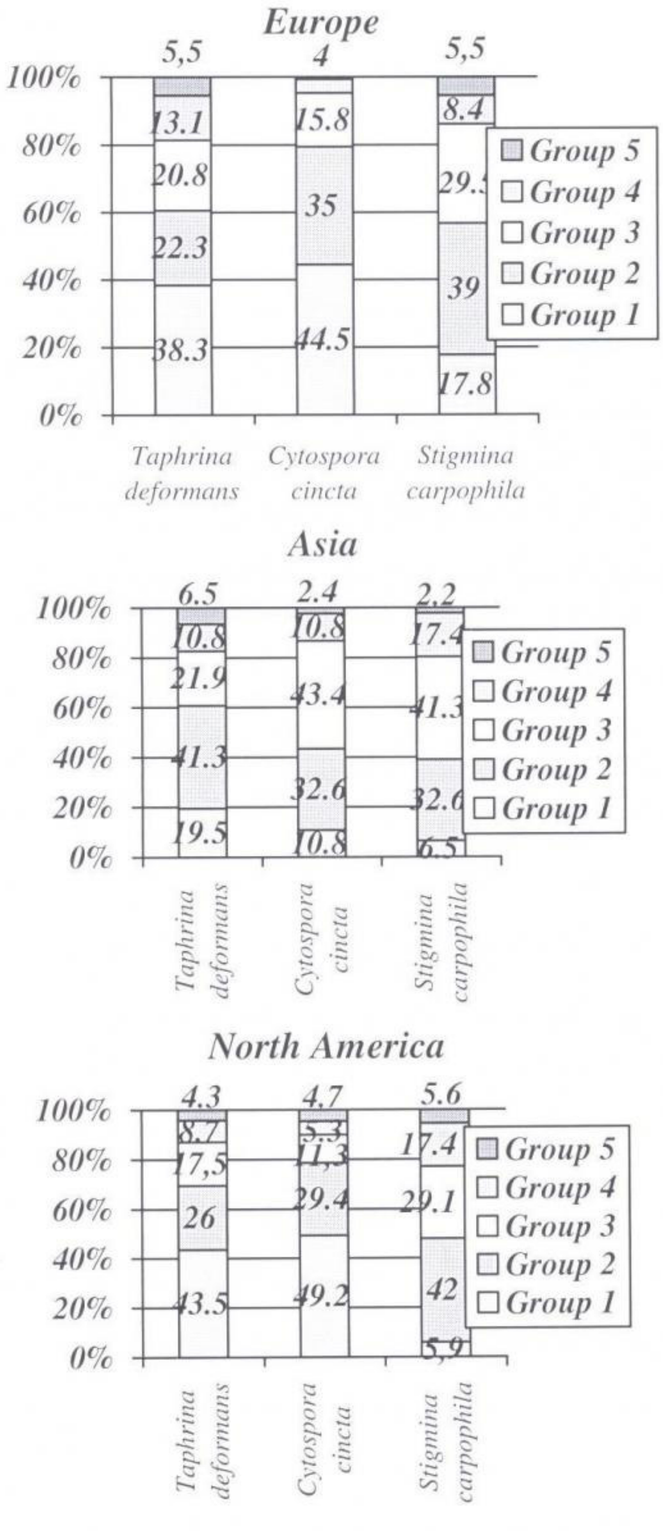

Figure 1 Distribution of the cultivar resistance groups for *Taphrina deformans*, *Cytospora cyncta* and *Stigmina carpophila* in Europe, Asia and North America

Literature cited

Benedek, P., Nyéki, J. & Vályi, I. (1990): Csonthéjas gyümölcsfajták érzékenysége a fontosabb kórokozókkal és kártevőkkel szemben – a fajtaspecifikus növényvédelmi technológia kidolgozása. Növényvédelem 26: 12–31.

Benedek, P., Szabó, Z., Soltész, M., Nyéki, J. & Kovács, J. (1993): Fruit varieties, plant disease susceptibility, pest control and cultivar improvement. Hungarian Agricultural Research. 2 (2): 4–10.

Holb, I. J. (2000): Disease progress of apple scab caused by *Venturia inaequalis* in environmentally friendly growing systems. International Journal of Horticultural Science. 6. (4): 56–62.

Holb, I. J. (2003): The brown rot fungi of fruit crops (*Monilinia* spp.) I. Important features of their biology (Review). International Journal of Horticultural Science. 9 (3–4): 23–36.

Holb I. (2005): Effect of pruning on disease incidence of apple scab and powdery mildew in integrated and organic apple production. International Journal of Horticultural Science. 11 (1): 57–61.

Ivascu, A. & Balan, V. (1994): Behaviour of some peach and nectarine cultivars and hybrids at the attack of mildew under the climatic conditions of the southern area of Romania. The XXIV-th Int. Hort. Congres Kyoto, Japan, 21–27 Aug.

Ivascu, A., Balan, V. & Toma, S. (1996): Peach and nectarine genitors with highly resistant to powdery mildew. Scientific Sessions ICPP vol. XIX, Pitesti

Jones, A. L. & Aldwinckle, H. S. (1990): Compendium of Apple and Pear Diseases. APS Press. St. Paul, Minnesota.

Kervella, J., Pascal, T., Pfeiffer, F. & Dirlenwanger, E. (1998): Breeding for multiresistance in peach trees, Acta Horticulturae 465:177–181.

Roselli, G. & Bellini, E. (1976): Indagini sulla suscettibilita all oidio *Sphaerotheca pannosa* (Wallr.) Lev. var. *persicae* in una collezione di cultivar di pesco. Rivista dell'Ortoflorofruticultura italiana, 1: 60–66

Simeone, A. M. (1987): Osservazioni su alcuni caratteri morfologici e sulla sensibilita del pesco (*Prunus persica vulgaris* Stokes.) alla *Sphaerotheca pannosa* (Wallr. Fr.) Lev. e alla *Taphrina deformans* Berk. Tull., Informattore fitopatologico, XXXVII, Roma 24: 14–20.

Toma S., Ivascu, A. & Oprea, M. (1998): Highlights of epidemiology of the fungus *Sphaerotheca pannosa* var. *persicae* in the southern zone of Romania. Acta Hort. 465: 709–714.

Toma, S. & Ivascu, A., (1997): Behaviour of some peach and nectarine varieties and hybrids to mainly diseases: leaf curl and powdery mildew in Romania. Int. Hort. Sci. Conf., Lednice na Morave, 9 – 12 September.

Toma, S., Ivascu, A., Oprea, M. & Delian, E. (2003): Evaluation of powdery mildew resistance at some peach and nectarine cultivars and hybrids by physiological parameters, Acta Hort. 623: 291–298.