Adaptation of peach-nectarine varieties to different soil and climatic conditions of Greece

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ABSTRACT: Forty two peach-nectarine (Prunus persica [L.] Batsch.) varieties (i.e Spring Time, Precocissima Morettini, Southhaven L., Halehaven, Blazing Gold, Cardinal, Gialla Precoce Morettini, Dixired, Fertilia Morettini, Golden Jubilee, Coronet, Red Haven, Red Globe, Cotonia Massima, Morettini 5/14, Peach of Station, Alexander, Early Elberta, Elberta of Middle Season, Beauty of Georgia, J.H.Hale, Late Elberta, Gold Drest, Morettini No. 1, Jerseyland, Desert Gold, Red Cup, Spring Crest, Loring, June Gold, Merril Gem Free, Early Red, Red Skin, Merril Fortyminer, Roubidoux, Fantasia, Sunhaven, Flavour Top, Merril Franciscan, Blake, Fairtime, Fayette) were studied for 12–18 years in three experimental orchards of Peripheral Agricultural Research Station of Rhodes (PARSR). Their degree of adaptation to the soil and climatic conditions of PARSR was evaluated in terms of yield per tree, time of bloom, time of fruit ripening, fruit quality etc. These results have been compared with related experimental data recorded at the Pomology Institute (PI) at Naoussa. The results indicate that: many peach-nectarine varieties with quite high chilling requirements (Loring, Blake) gave satisfactory yield in PARSR, where the mean average of temperatures below 7°C over one decade was found to be 147 hours (range 52–226). Some peach-nectarine varieties in experimental orchards of PARSR ripened more than ten days earlier (Desert Gold, Early Red, Peach of Station, Loring, Merril Gem Free), of others at about the same time (Coronet, Cotonia Massima, Red Skin, Fertilia Morettini, Red Globe) and at others on a later date (Merril Fortyminer, Early Elberta, J.H.Hale, Cardinal, Southhaven) than they would ripen in northern Greece (PI). Similar differences were also found for the time of blooming.

Keywords: peaches; nectarines; chilling; adaptation; climatic conditions; time of ripening; time of flowering; yields

On the island of Rhodes two hundred hectares have been cultivated with peaches. Although the yield per hectare is relatively low (15 tones per hectare), the farmers achieve high prices per kilogram and the profit per hectare is relatively high, for the following reasons:

1. The soil climatic conditions favour early-late ripening of fruits compared with other areas of northern Greece.
2. The fruits (because the consumption of fruits occurs at the place of production) are harvested at full maturity and so are more tasty and the size of the fruits is bigger than those of northern Greece.
3. The peaches produced have lower cost of transportation, which is also safer, and is not dependent on the schedules of ferryboats.
4. Rhodes is one of the most "touristic" islands of the small country and has a high rate of consumption for fruit and vegetable during the summer.

For these reasons there is great interest in peach growing. The main limiting factor to extend peach cultivation in the south is temperature (BOWEN 1971). Insufficient fulfilment of the chilling requirements can result in delay and insufficient expansion of the flower and the shoot buds, and the tree may remain dormant (BOWEN 1971). One mathematical model, relates breaking of dormancy to the accumulated units of cold (RICHARDSON et al. 1974). In this model 6°C is considered as the optimum temperature, for the breaking of dormancy. Other researchers (SCALABRELLI, COUVILLON 1986) have found that 7.2°C was more effective than 3 or 2°C, where others (PHYLLIS, BUCHANAN 1981) have found that the continuous exposure of trees (var Sungold) to 10°C was as effective for the breaking of dormancy as 7°C.

Dormancy of peach-nectarine can be affected by pruning, irrigation (BAUER et al. 1976; BUCHANAN et al. 1977), fertilizer application, planting distance, the rootstock (GUERRIERO et al. 1986) and the variety (BOWEN 1971; WERNER et al. 1988). Although the majority of varieties require 800–1,000 hours (WANG, HU 1992) of chilling, there are varieties with a relatively shorter requirement for low temperature period (BOWEN 1971; SHERMAN 1988).

The goal of our experiment was to make available varieties, which are better adapted to the soil-climatic conditions prevalent in Rhodes, expand or increase their production, and utilise the microclimate of Rhodes.

MATERIALS AND METHODS

The first peach-nectarine experimental orchard was established at Peripheral Agricultural Research Station of

Table 1. Soil analysis of PARSR farm

Depth (cm)	Mechanical analysis			Characterisation of soil	Electric conductivity	Salt (%)	pH in pulp	$CaCO_3$	Water holding capacity	Organic mater (%)	Total N (mg/100 g)
	Clay (%)	Loam (%)	Sand (%)								
0–30	31	32	37	clay loamy	< 3	< 0.14	7.8	26	56	1.4	8.3
30–60	36	30	34	clay loamy	< 3	< 0.14	7.8	31	56	1.0	–
60–90	27	27	46	sandy loamy	< 3	< 0.11	7.8	29	48	0.4	–

Table 2. Soil analysis of the PI farm

Depth (cm)	Mechanical analysis			Characterisation of soil	Electric conductivity	Salt (%)	pH in pulp	$CaCO_3$	Water holding capacity	Organic mater (%)	Total N (mg/100 g)
	Clay (%)	Loam (%)	Sand (%)								
0–30	34.2	29.8	36.0	clay loamy	< 3	7.2	7.2	4.7	51	1.7	10.2
30–60	44.4	25.2	30.4	clay	< 3	7.5	7.5	7.8	65	–	–
60–90	39.6	30.0	30.4	clay loamy	< 3	7.8	7.8	–	59	–	–

Rhodes (PARSR) in 1966. This orchard comprised the following 14 varieties: Spring Time, Precocissima Morettini, Southhaven, Halehaven, Blazing Gold, Cardinal, Gialla Precoce Morettini, Dixired, Fertilia Morettini, Golden Jubilee, Coronet, Red Haven, Red Globe, Cotonia Massima. The second experimental orchard was established in 1968 close to the first. It included 11 varieties: Morettini 5/14, Peach of Station, Alexander, Early Elberta, Elberta of Middle Season, Beauty of Georgia, J.H. Hale, Late Elberta, Gold Drest, Morettini No. 1, Jerseyland. The third orchard was established in 1972 close to the second and consisted of 17 varieties: Desert Gold, Red Cup, Spring Crest, Loring, June Gold, Merril Gem Free, Early Red, Redskin, Merril Fortyminer, Roubidoux, Fantasia, Sunhaven, Flavour Top, Merril Franciscan, Blake, Fairtime, Fayette. All the peach-nectarine varieties of the three collections were budded on wild peach seedling rootstocks.

The three experimental orchards were established in a randomised design with three replications of two trees each. The planting distances were 4 × 4 m. The experimental collections were established on land which had carried citrus trees for 80 years.

The altitude of the orchards was 6 m above sea level and the distance from the sea was 600 m. The soil was sandy to sandy-loamy (Table 1). The water used for irrigation was of good quality consisting of 350 ppm total salts /liter, 1.3 mg/liter of Cl, with a low content of Ca^{++}, Mg^{++}, Na^{+}, ions and with alkaline degree 23.4.

The climate is generally mild with a mean day temperature of 13.7°C during the winter and 24.1°C during the summer. The summer is cool with the highest temperature occurring in July or August (Table 3). The north side of the farms is protected from the wind by a 3 m wall and reeds or olive trees. The relative humidity varies from 69.8 to 72.1% during the winter and from 61.5 to 67.7%

Table 3. Absolute maximum and minimum air temperature (°C) during the years 1981–1990 and the relative months during which observed at PARSR and PI

Year	RHODES		NAOUSSA	
	Max/Min	Months where observed	Max/Min	Months where observed
1981	34.8/4.2	June/February	37.0/–7.0	August/February
1982	35.2/4.0	June/February	39.5/–6.7	June/February
1983	34.2/1.2	July/February	38.0/–9.0	July/February
1984	33.8/7.0	June/January	34.0/–5.0	July/December
1985	34.6/3.0	August/February	36.0/–10.0	July + August/February
1986	35.8/6.0	July/January	35.0/–10.5	August/December
1987	38.0/1.8	July/March	38.0/–11.5	July/January
1988	37.8/5.6	July/February	36.0/–9.5	August/December
1989	32.8/3.2	May/January	35.0/–7.0	July + August/November + December
1990	34.0/6.0	June/January	34.5/–7.7	July/January
Mean	35.1/4.2		36.3/–8.4	

Table 4. Peach – nectarine blooming period at Rhodes and Naoussa

No.	Variety	Blooming period				Blooming span (days)	
		Start		End			
		Rhodes	Naoussa	Rhodes	Naoussa	Rhodes	Naoussa
1	Spring Time	17/3 a	16/3 a	31/3 b	25/3 a	14 b	9 a
2	Precocissima Morettini	20/3 a	30/3 b	3/4 a	6/4 a	14 b	7 a
3	Southhaven	27/3 b	18/3 a	12/4 b	27/3 a	16 b	9 a
4	Halehaven	28/3 b	19/3 a	15/4 b	26/3 a	18 b	7 a
5	Blazing Gold	23/3 a	28/3 b	8/4 a	6/4 a	16 b	9 a
6	Cardinal	31/3 b	22/3 a	17/4 b	29/3 a	17 b	7 a
7	Gialla Precoce Morettini	22/3 a	25/3 a	8/4 b	2/4 a	17 b	8 a
8	Dixired	26/3 a	23/3 a	12/4 b	28/3 a	17 b	5 a
9	Fertilia Morettini	3/4 b	29/3 a	19/4 b	7/4 a	16 b	9 a
10	Golden Jubilee	23/3 a	26/3 a	7/4 b	2/4 a	15 b	7 a
11	Coronet	23/3 b	18/3 a	8/4 b	26/3 a	16 b	8 a
12	Red Haven	2/4 b	21/3 a	15/4 b	26/3 a	13 b	5 a
13	Red Globe	2/4 b	21/3 a	14/4 b	29/3 a	12 a	8 a
14	Cotonia Massima	17/3 a	16/3 a	31/3 b	22/3 a	14 b	6 a
15	Morettini 5/14	19/3 a	29/3 b	14/4 b	3/4 a	26 b	5 a
16	Peach of Station	19/3 a	23/3 b	2/4 b	28/3 a	14 b	5 a
17	Alexander	21/3 a	25/3 b	15/4 b	1/4 a	25 b	7 a
18	Early Elberta	20/3 a	24/3 b	18/4 b	1/4 a	29 b	8 a
19	Elberta of Middle Season	20/3 a	28/3 b	16/4 b	1/4 a	27 b	4 a
20	Beauty of Georgia	19/3 a	29/3 b	15/4 b	2/4 a	27 b	4 a
21	J. H. Hale	30/3 b	22/3 a	16/4 b	28/3 a	17 b	6 a
22	Late Elberta	20/3 a	29/3 b	8/4 b	2/4 a	19 b	4 a
23	Gold Drest	22/3 a	24/3 a	15/4 b	31/3 a	24 b	7 a
24	Morettini No. 1	22/3 a	29/3 b	18/4 b	4/4 a	27 b	6 a
25	Jerseyland	26/3 a	28/3 a	20/4 b	3/4 a	25 b	6 a
26	Desert Gold	19/2 a	7/3 b	11/3 a	22/3 b	20 b	15 a
27	Red Cup	22/3 a	24/3 a	9/4 b	31/3 a	18 b	7 a
28	Spring Crest	19/3 a	20/3 a	31/3 a	30/3 a	12 a	10 a
29	Loring	18/3 a	20/3 a	10/4 b	26/3 a	23 b	6 a
30	June Gold	13/3 a	13/3 a	5/4 b	20/3 a	23 b	7 a
31	Merril Gem Free	25/3 a	24/3 a	14/4 b	29/3 a	20 b	5 a
32	Early Red	25/3 a	24/3 a	13/4 b	28/3 a	19 b	4 a
33	Red Skin	26/3 b	19/3 a	13/4 b	26/3 a	18 b	7 a
34	Merril Fortyminer	19/3 a	20/3 a	10/4 b	26/3 a	22 b	6 a
35	Roubidoux	14/3 a	22/3 b	3/4 b	28/3 a	20 b	6 a
36	Fantasia	26/3 b	18/3 a	15/4 b	29/3 a	20 b	11 a
37	Sunhaven	24/3 b	19/3 a	14/4 b	25/3 a	21 b	6 a
38	Flavour Top	15/3 a	19/3 b	8/4 b	29/3 a	24 b	10 a
39	Merril Franciscan	23/3 a	22/3 a	15/4 b	27/3 a	23 b	5 a
40	Blake	23/3 a	21/3 a	13/4 b	28/3 a	21 b	7 a
41	Fairtime	19/3 a	19/3 a	12/4 b	31/3 a	24 b	12 a
42	Fayette	16/3 a	18/3 a	11/4 b	1/4 a	26 b	14 a
	Total mean	21/3 a	22/3 a	10/4 b	29/3 a	20 b	7 a

Note: Means between compared pairs within rows with the same letters are not statistically different at $P = 0.05$

during the summer. The mean annual rainfall measured over a decade is 665 mm, and most of the rainfall occurs during November to May. All trees were trained to a vase shape with three to five main branches and three subbranches each. During experimentation, all culturing practices were carried out as in commercial practice (pruning, spraying, thinning, irrigation etc.). Observations made of the behaviour of different varieties included blooming, fruit maturity, yield, fruit quality and susceptibility to pests and diseases etc.

Similar experimental orchards were established in P.I. Naoussa, where the temperatures fall bellow 7°C for more than 1,000 hours and the climate is more continental. The peach-nectarine varieties were also grafted on wild peach seedlings, but the planting distances were bigger (5 × 5 m) to allow trees to grow freely for a more fertile soil. Also, trees were established in a randomised experimental design with three replications of two trees each.

The soil analyses of the orchards and climatic data are presented on Tables 2 and 3. Temperatures below 7°C were adequate to cover the requirements of all the varieties. The cultural practices and observations taken were similar of those taken at PARSR.

RESULTS

The results of peach-nectarine bloom are given in Table 4. Table 5 shows the time of ripening. Tables 6 and 7 show the yield and the mean fruit weight for the experimental orchards in PARSR and P.I.

Blooming: Some peach-nectarine varieties in the experimental orchards of PARSR bloomed earlier (Desert Gold, Morettini 5/14, Beauty of Georgia, Precocissima Morettini, Morettini No. 1), others at the same time (June Gold, Fairtime, Loring, Jerseyland, Cotonia Massima), and others later (Red Haven, Red Globe, Cardinal, Halehaven, Red Skin) than the normal bloom in Northern Greece (PI).

The blooming period and the duration of bloom was longer at PARSR than at PI, and particularly in case of the varieties Beauty of Georgia, Morettini No. 1, Elberta of Middle Season, Elberta, Morettini 5/14.

Ripening: Some peach-nectarine varieties reached time of their fruit ripening at PARSR more than 10 days earlier (Desert Gold, Early Red, Peach of Station, Loring, Merril Gem Free), others at the same time (Coronet, Cotonia Massima, Red Skin, Fertilia Morettini, Red Globe), and others later (Merril Fortyminer, Early Elberta, J.H.Hale, Cardinal, Southhaven) than they ripen in Northern Greece (PI).

Yield per tree: The highest yield per tree at PARSR was found in the varieties Blake, Loring, Morettini No. 1, Flavour Top, Fantasia and Merril Gem Free, and the smallest yield per tree was recorded in the varieties Halehaven, Southhaven, Coronet and Red Globe.

DISCUSSION AND CONCLUSIONS

Table 4 shows that peach-nectarine varieties which bloom during the same period at PI do not bloom at the same time at PARSR. This fact needs to be taken into account in the case of self-sterile varieties. Particularly, the self-sterile variety J.H. Hale is cross pollinated by cv. Cardinal, Red Haven, which blooms at the same time as J.H. Hale at PI, is not a good pollinator in Rhodes because its blooming period is different from J.H. Hale. We suggest the use of a different pollinator for J.H. Hale in Rhodes blooming during the same period as J.H. Hale, and having fertile pollen for example Elberta, Jerseyland, and Cardinal.

Late blooming at PARSR in relation to PI of varieties mainly with a high chilling requirement (Cardinal, J.H. Hale, Red Haven) is probably due to production of ethylene as a stress response of varieties which were cultivated in an environment unsuitable for them. The ethylene produced possibly, together with ABA, delayed the transformation of pistil and blooming as well (PHYLLIS, BUCHANAN 1981). It has been found (PHYLLIS, BUCHANAN 1981) that ABA levels were significantly higher in buds treated with ethylene compared with those in the control group. Other researchers (APELBAUM, BURG 1972) have reported that there was an interference with DNA composition and cell division in peas after ethylene treatment.

Early blooming occurred possibly due to adequate chilling to cover all requirements of varieties, and favourable high temperatures advanced flower-shoot bud burst. The blooming period and blooming duration of varieties were longer at PARSR than at PI. This bloom duration is possibly due to longer dormancy of such varieties and not due to unfavourable growth conditions. The temperatures at PARSR are generally more stable and they do not show great fluctuations from year to year as in PI.

The ripening period of fruits showed the same tendency as the blooming period. The yield was very low at PARSR compared with that at PI. Many peach-nectarine varieties with quite high chilling requirements (Loring, Blake, Fantasia) gave a relatively satisfactory yield at PARSR, where the mean temperatures below 7°C for one decade was only 147 hours (range 52–335), while normally the requirement of these varieties is more than 800 hours. Possibly other temperature effects acted to break dormancy. For instance, it has been reported (PHYLLIS, BUCHANAN 1981) that continuous exposure of the nectarine cultivar Sungold to 10°C was as effective as 7°C. Of course, the winter-spring temperatures in Rhodes are quite high and one would expect a negative effect on the breaking of dormancy. It has been reported (WEINBERGER 1954) that the growth of bloom and shoot buds could be retarded by exposure of peach branches for 3 days to 37.8°C and 9 days at over 32.2°C. (Such temperatures do not occur in the climate of Rhodes.)

On the other hand, other researchers (BOWEN 1971) reported that two different breaking periods of 11 and 12 days at 20°C do not negatively affect the breaking of dormancy. It seems that temperatures over 7°C as well are other factors (internal and external) are probably involved in the breaking of dormancy (EREZ, LAVEE 1971;

Table 5. Peach – nectarine ripening period at Rhodes and Naoussa

No.	Variety	Ripening period				Ripening span (days)	
		Start		End			
		Rhodes	Naoussa	Rhodes	Naoussa	Rhodes	Naoussa
1	Spring Time	26/5 a	1/6 b	5/6 a	12/6 b	10 a	11 a
2	Precocissima Morettini	8/6 a	12/6 b	20/6 a	18/6 a	12 a	6 b
3	Southhaven L.	20/6 a	21/6 a	28/6 a	30/6 a	8 a	9 a
4	Halehaven	24/6 a	20/7 b	7/7 a	4/8 b	13 a	15 a
5	Blazing Gold	21/6 a	18/6 a	1/7 a	1/7 a	10 a	13 a
6	Cardinal	14/7 b	21/6 a	22/7 b	29/6 a	8 a	8 a
7	Gialla Precoce Morettini	18/6 a	20/6 a	26/6 a	30/6 a	8 a	10 a
8	Dixired	20/6 a	23/6 a	1/7 a	2/7 a	11 a	9 a
9	Fertilia Morettini	27/6 a	26/6 a	4/7 a	5/7 a	7 a	9 a
10	Golden Jubilee	3/7 a	12/7 b	18/7 a	21/7 a	15 a	9 b
11	Coronet	3/7 a	3/7 a	12/7 a	12/7 a	9 a	9 a
12	Red Haven	11/7 b	7/7 a	19/7 a	17/7 a	8 a	10 a
13	Red Globe	19/7 a	20/7 a	30/7 a	28/7 a	11 a	8 a
14	Cotonia Massima	12/9 a	13/9 a	21/9 a	21/9 a	9 a	8 a
15	Morettini 5/14	12/6 a	22/6 b	24/6 a	30/6 b	12 a	8 b
16	Peach of Station	29/7 a	14/8 b	10/8 a	27/8 b	12 a	13 a
17	Alexander	8/7 a	16/7 b	16/7 a	25/7 b	8 a	9 a
18	Early Elberta	29/7 b	16/7 a	7/8 b	27/7 a	9 a	11 a
19	Elberta of Middle Season	3/8 a	1/8 a	12/8 a	11/8 a	9 a	10 a
20	Beauty of Georgia	26/7 a	10/8 b	7/8 a	18/8 b	12 a	8 a
21	J. H. Hale	23/8 b	12/8 a	28/8 a	22/8 a	5 b	10 a
22	Late Elberta	8/8 a	16/8 b	13/8 a	25/8 b	5 a	9 a
23	Gold Drest	18/6 a	21/6 a	29/6 a	6/7 b	11 b	15 a
24	Morettini No. 1	12/6 a	15/6 b	25/6 a	5/7 b	13 b	20 a
25	Jerseyland	26/6 a	1/7 b	10/7 a	9/7 a	14 a	8 b
26	Desert Gold	23/5 a	18/6 b	1/6 a	27/6 b	9 a	9 a
27	Red Cup	16/6 a	25/6 b	23/6 a	4/7 b	7 a	9 a
28	Spring Crest	7/6 a	10/6 a	14/6 a	19/6 a	7 a	9 a
29	Loring	13/7 a	25/7 b	22/7 a	6/8 b	9 a	12 a
30	June Gold	6/6 a	15/6 b	17/6 a	25/6 b	11 a	10 a
31	Merril Gem Free	12/6 a	23/6 b	22/6 a	1/7 b	10 a	8 a
32	Early Red	7/6 a	23/6 b	17/6 a	30/6 b	10 a	7 a
33	Red Skin	11/8 a	10/8 a	19/8 a	19/8 a	8 a	9 a
34	Merril Fortyminer	26/7 b	7/7 a	17/8 a	15/7 a	22 a	8 b
35	Roubidoux	29/8 a	1/9 a	6/9 a	12/9 b	8 b	11 a
36	Fantasia	25/7 a	30/7 a	4/8 a	11/8 b	10 b	12 a
37	Sunhaven	15/6 a	22/6 b	22/6 a	3/7 b	7 b	11 a
38	Flavour Top	17/7 a	22/7 b	25/7 a	3/8 b	8 b	12 a
39	Merril Franciscan	25/7 a	31/7 b	4/8 a	11/8 a	10 a	11 a
40	Blake	1/8 a	5/8 b	10/8 a	14/8 a	9 a	9 a
41	Fairtime	6/9 a	5/9 a	12/9 a	10/9 a	6 a	5 a
42	Fayette	9/8 a	7/8 a	16/8 a	17/8 a	7 a	10 a
	Total mean	8/7 a	12/7 b	18/7 a	22/7 b	10 a	10a

Note: Means between compared pairs within rows with the same letters are not statistically different at $P = 0.05$

Table 6. Peach – nectarine mean yield per tree at Rhodes and Naoussa

No	Variety	Mean yield per tree (kg)	
		Rhodes	Naoussa
1	Spring Time	7.6 b	45.1 a
2	Precocissima Morettini	20.6 b	53.5 a
3	Southhaven	5.4 b	50.6 a
4	Halehaven	4.3 b	45.4 a
5	Blazing Gold	9.3 b	60.6 a
6	Cardinal	7.2 b	48.2 a
7	Gialla Precoce Morettini	11.7 b	75.3 a
8	Dixired	14.7 b	81.4 a
9	Fertilia Morettini	8.2 b	92.3 a
10	Golden Jubilee	20.7 b	104.7 a
11	Coronet	5.9 b	73.8 a
12	Red Haven	10.3 b	108.2 a
13	Red Globe	8.7 b	63.7 a
14	Cotonia Massima	13 b	75.0 a
15	Morettini 5/14	19.5 b	78.8 a
16	Peach of Station	20.2 a	33.5 a
17	Alexander	7.5 b	60.8 a
18	Early Elberta	13.5 b	126.3 a
19	Elberta of Middle Season	14.4 b	103.8 a
20	Beauty of Georgia	13.5 b	40.8 a
21	J. H. Hale	5.6 b	51.6 a
22	Late Elberta	5.8 b	60.4 a
23	Gold Drest	16.3 b	76.6 a
24	Morettini No. 1	22.3 b	78.7 a
25	Jerseyland	18.3 b	111.1 a
26	Desert Gold	16.7 b	43.0 a
27	Red Cup	11.7 b	57.6 a
28	Spring Crest	11.9 b	25.8 a
29	Loring	22 b	80.2 a
30	June Gold	21 b	49.9 a
31	Merril Gem Free	21.5 b	58.6 a
32	Early Red	15.3 b	59.8 a
33	Red Skin	17 b	65.4 a
34	Merril Fortyminer	16.5 b	80.9 a
35	Roubidoux	10.8 b	78.2 a
36	Fantasia	21 b	41.9 a
37	Sunhaven	16.9 b	70.1 a
38	Flavour Top	22 a	24.5 a
39	Merril Franciscan	20.3 b	54.6 a
40	Blake	25.5 b	49.9 a
41	Fairtime	20.2 b	79.2 a
42	Fayette	17.2 b	72.3 a
	Total	14.6 b	66.5 a

Note: Means within rows with the same letters are not statistically different at $P = 0.05$

Table 7. Peach – nectarine mean fruit weight at Rhodes and Naoussa

No	Variety	Mean fruit weight (g)	
		Rhodes	Naoussa
1	Spring Time	80.4 b	95.0 a
2	Precocissima Morettini	86.0 a	96.0 a
3	Southhaven L.	136.6 b	152.0 a
4	Halehaven	135.0 b	154.0 a
5	Blazing Gold	103.1 b	127.0 a
6	Cardinal	138.0 b	160.0 a
7	Gialla Precoce Morettini	160.2 a	141.0 b
8	Dixired	107.1 b	143.0 a
9	Fertilia Morettini	157.6 a	158.0 a
10	Golden Jubilee	128.3 b	147.0 a
11	Coronet	115.0 b	180.0 a
12	Red Haven	146.4 b	179.0 a
13	Red Globe	161.8 b	231.0 a
14	Cotonia Massima	136.4 b	165.0 a
15	Morettini 5/14	143.5 a	155.0 a
16	Peach of Station	138.3 b	227.0 a
17	Alexander	197.0 b	250.0 a
18	Early Elberta	161.7 a	173.0 a
19	Elberta of Middle Season	150.0 b	203.0 a
20	Beauty of Georgia	119.3 b	168.0 a
21	J. H. Hale	175.0 b	231.0 a
22	Late Elberta	160.0 b	222.0 a
23	Gold Drest	87.1 b	116.0 a
24	Morettini No. 1	145.0 a	152.0 a
25	Jerseyland	150.6 b	175.0 a
26	Desert Gold	72.0 b	126.0 a
27	Red Cup	111.7 b	158.0 a
28	Spring Crest	113.0 b	129.0 a
29	Loring	180.0 b	227.0 a
30	June Gold	127.0 b	176.0 a
31	Merril Gem Free	123.0 b	168.0 a
32	Early Red	117.0 b	142.0 a
33	Red Skin	160.0 b	238.0 a
34	Merril Fortyminer	158.0 b	224.0 a
35	Roubidoux	154.0 b	237.0 a
36	Fantasia	175.0 a	183.0 a
37	Sunhaven	129.0 b	178.0 a
38	Flavour Top	126.0 b	158.0 a
39	Merril Franciscan	169.0 b	227.0 a
40	Blake	145.0 b	202.0 a
41	Fairtime	136.0 b	238.0 a
42	Fayette	143.0 b	195.0 a
	Total	137.1 b	176.3 a

Note: Means within rows with the same letters are not statistically different at $P = 0.05$

PAPANICOLAOU et al. 1991a,b). This may also be the reason why tables (presented by different workers) of the chilling requirements (hours below 7°C) for the breaking of dormancy differ significantly between researchers for the same varieties, when their experimental orchards are in different latitudes (FRECON 1988; TORROBA 1988).

From the peach-nectarine varieties studied in this paper, those of interest for the southern areas of Greece are:

1. Early ripening varieties, which show earliness and are well adapted to soil climatic conditions of Rhodes (e.g. Spring Time, Spring Crest, June Gold). These cultivars that are evaluated in PI and PARSR and have low chilling requirements (e.g. San Pedro, Flordaking, Maravilha) could meet the demands for early-maturing peaches of the Island or for export, especially under protected cultivation.

2. Mid and late ripening varieties, although they have quite high chilling requirements, are well adapted and produce satisfactory yields under the soil and climatic conditions of Rhodes. These varieties could meet the demands of the Island for peaches of high quality (e.g. Loring, Fantasia) during the touristic period.

The relative low yield per tree at PARSR could be improved by using the peach – almond hybrid GF 677 as rootstock, which in the course of experimental work has shown that it is well adapted to the soil and climatic conditions of Rhodes and would increase the yield of the Island per tree.

References

APELBAUM A., BURG S.P., 1972. Effect of ethylene on cell division and deoxyribonucleic acid synthesis in *Pisum sativum*. Plant Physiol., *50*: 117–124.

BAUER M., CHAPLIN C.E, SCHNEIDER G.W., BARFIELD B.J., WHITE G.M., 1976. Effects of evaporative cooling during dormancy on "Redhaven" peach wood, and fruit bud hardiness. J Amer. Soc. Hort. Sci., *101*: 452–454.

BOWEN H.H., 1971. Breeding peaches for warm climates. HortScience, *6*: 153–157.

BUCHANAN D.W., BARTOLIC J.F., BIGGS R.H., 1977. Manipulation of bloom and ripening dates of three Florida grown peach and nectarine cultivars through sprinkling and shade. J. Amer. Soc. Hort. Sci., *102*: 466–470.

EREZ A., LAVEE S., 1971. The effect of climatic conditions on dormancy development of peach buds. J. Amer. Soc. Hort. Sci., *96*: 711–714.

FRECON J.L., 1988. Fresh market peach cultivars in Eastern North America. In: CHILDERS N.F., SHERMAN W.B. (eds.), The Peach. Hort. Publications. Fruit Crops, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, U.S.A.

GUERRIERO R., INDIOGINE S.E.P., SCALABRELLI G., 1986. Variations in the ratios between percentage opening of leaf and flower buds in peach, as a function of experimental cold conditions during the course of dormancy. Riv. Ortoflorofruttic. Ital., *70* (6): 247–256.

PAPANICOLAOU X., STILIANIDIS D., TSIPOURIDIS C., 1991. Prosarmosticotita 42 pikilion rodakinias – nectarinias stis edafoklimatikes sinthikes tou P.S.G.E. Rodou. Practika 15 Epistimonikis Synedriasis tis E.E.E.O.: 7.

PAPANICOLAOU X., STILIANIDIS D., TSIPOURIDIS C., 1991. Prosarmostikotita – apodosis 12 pikilion rodakinias – nektarinias diamorfomenon se kipelo i atrakto ston Periferiako Stathmo Georgikis Erevnas Rodou. Practika 15 Epistimonikis Synedriasis tis E.E.E.O.: 8.

PHYLLIS R.G., BUCHANAN D.W., 1981. Rest prediction model for low-chilling "Sungold" nectarine. J. Amer. Soc. Hort. Sci., *106*: 426–429.

RICHARDSON E.A., SEELEY S.D., WALKER D.R., 1974. A model for estimating the completion of rest for "Redhaven" and "Elberta" peach trees. HortScience, *9*: 331–332.

SCALABRELLI G., COUVILLON G.A.,1986. The effect of temperature and bud type on rest completion and the growing degree hours (GDH°C) requirement for budbreak in "Redhaven" peach. J. Amer. Soc. Hort. Sci., *111*: 537–540.

SHERMAN W.B., 1988. Low-chill peaches and nectarines. In: CHILDERS N.F., SHERMAN W. B. (eds.), The Peach. Hort. Publications. Fruit Crops, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, U.S.A.

TORROBA C., 1988. Peach culture in the Republic of Argentina. In: CHILDERS N.F., SHERMAN W. B. (eds.), The Peach. Hort. Publications. Fruit Crops, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, U.S.A.

WANG L.R., HU Y.Y., 1992. Study on the chilling requirement of peach cultivars. Hort. Abs V.62, N. 9 (7165).

WEINBERGER J.H., 1954. Effects of high temperatures during the breaking of the rest of Salivan Elberta peach buds. Proc. Amer. Soc. Hort. Sci., *63*: 157–162.

WERNER D.J., MOWREY B.D., YOUNG E., 1988. Chilling requirement and post-rest heat accumulation as related to difference in time of bloom between peach and western sand cherry. J. Amer. Soc. Hort. Sci., *113*: 775–778.

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Adaptace odrůd broskvoní a nektarinek na rozdílné půdní a klimatické podmínky Řecka

ABSTRAKT: Po dobu 12–18 let jsme ve třech pokusných výsadbách Periferní zemědělské výzkumné stanice na Rhodu (P.A.R.S.R.) sledovali 42 odrůd broskvoní a nektarinek (Spring Time, Precocissima Morettini, Southhaven L., Halehaven, Blazing Gold, Cardinal, Gialla Precoce Morettini, Dixired, Fertilia Morettini, Golden Jubilee, Coronet, Red Haven, Red Globe, Cotonia Massima, Morettini 5/14, Peach of Station, Alexander, Early Elberta, Elberta of Middle Season, Beauty of Georgia, J.H. Hale, Late Elberta, Gold Drest, Morettini No. 1, Jerseyland, Desert Gold, Red Cup, Spring Crest, Loring, June Gold, Merril Gem Free, Early Red, Red Skin, Merril Fortyminer, Roubidoux, Fantasia, Sunhaven, Flavour Top, Merril Franciscan, Blake, Fairtime a Fayette). Hodnotili jsme stupeň jejich adaptace na místní půdní a klimatické podmínky na základě výnosů, doby kvetení, doby dozrávání plodů, hmotnosti plodů a dalších charakteristik. Tyto výsledky jsme porovnávali s výsledky hodnocení těchto odrůd ve Výzkumném ústavu ovocnářském (P.I.) v Naoussa. Výsledky naznačují, že četné odrůdy broskvoní a nektarinek s dosti vysokými požadavky na období chladu přinášejí na ostrově Rhodos uspokojivé výnosy, přestože zde průměrná doba působení teplot pod 7 °C trvala pouze 147 hodin (roční kolísání v rozsahu 52–226 h). Plody některých odrůd broskvoní a nektarinek v pokusných výsadbách na ostrově Rhodos dozrávaly o 10 dní dříve (Desert Gold, Early Red, Peach of Station, Loring, Merril Gem Free), jiných ve stejnou dobu (Coronet, Cotonia Massima, Red Skin, Fertilia Morretini, Red Globe) a dalších později (Merril Fortyminer, Early Elberta, J.H. Hale, Cardinal, South Haven L.) než dozrávaly v podmínkách severního Řecka. Podobné rozdíly jsme zjistili také v době kvetení stromů.

Klíčová slova: broskvoně; nektarinky; období chladu; adaptace; doba kvetení; doba zrání; výnos

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