EVALUATION OF APPLE CULTIVARS WITH DIFFERENT SUSCEPTIBILITY TO SCAB (*Venturia inaequalis* ADERH.)

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A B S T R A C T

In the spring of 1995, one-year-old unfeathered trees of seven apple cultivars on M.9 rootstock with different levels of resistance to apple scab were planted 4.0 x 1.5 m apart in Przybroda near Poznań, Poland. No chemicals were used to protect the trees against apple scab. The cultivars tested were: 'Redkroft', 'Egeria', 'Medea', 'Ligol', 'Lodel', 'Pilot' and 'Pinova'. Among the cultivars tested, 'Redkroft', 'Egeria', 'Medea' and 'Lodel' were relatively resistant to apple scab and can be grown without chemical protection. 'Ligol', 'Pilot' and 'Pinova' were totally infected with scab in some years, and require chemical protection for profitable cultivation. 'Ligol' and 'Pinova' were the most vigorous of the cultivars tested, and 'Medea', 'Egeria' and 'Pilot' were the least vigorous. 'Lodel' and 'Pilot' had the highest eight-year cumulative yield, and 'Medea', 'Pinova', and 'Redkroft' had the lowest cumulative yield. 'Ligol' had by far the heaviest fruits, and 'Pinova' by far the lightest fruits. 'Pilot' had the best colored fruits, and 'Pinova' had the worst colored fruits.

Key words: apple, cultivar, growth, yielding, scab sensitivity

INTRODUCTION

A major problem for apple growers is apple scab, caused by the fungus *Venturia inaequalis*. In many countries, including Poland, breeding programs have been directed at developing new scab-resistant cultivars with good production value (Krüger 1989; Kellerhals 1994; Rouselle et al. 1974; Pitera 1992). Many cultivars with genetic resistance to scab have been developed, but most do not meet the expectations of growers and consumers, especially in terms of yield, fruit quality, and flavor. Some apple cultivars, while not totally resistant to apple scab, are resistant

enough to be grown with only light chemical protection, and in some years, with no chemical protection at all. The aim of this trial was to evaluate growth, yield, and scab infection in seven cultivars with different levels of scab resistance in western Poland.

MATERIAL AND METHODS

The trial was carried out from 1996 to 2003 at the orchard of the Experimental Station at Przybroda, which belongs to the Pomology Department of the Agricultural University in Poznań. The local soil is a heavy, brown, podzolic, Class IIIa post-glacial clay.

Local weather conditions for the eight-year trial period are presented in Figure 1 according to the method of Walter and Lieght (1970), by which mean monthly temperature and mean monthly rainfall are shown on the same graph in the proportion of 1ºC to 4.5 mm. The weather in Przybroda was moderately warm and moderately wet throughout the trial period.

In the spring of 1995, one-year-old unfeathered trees of seven apple cultivars on M.9 rootstock with different levels of resistance to scab were planted 4.0 x 1.5 m apart (1667 trees/ha) in four replicates of three trees per cultivar. The cultivars tested were: 'Redkroft', 'Egeria', 'Medea', 'Ligol', 'Lodel', 'Pilot' and 'Pinova'. Canopies were trained as spindles.

Agrotechnical practices followed commercial guidelines. Chemical pest and disease control was carried out in accordance with the current recommendations of the Orchard Protection Program, but no chemicals were used to protect the trees against apple scab.

In accordance with the method proposed by the Research Center for Cultivar Testing in Słupia Wielka, the level of infection by apple scab was recorded on a scale from 1 to 9, where 1 equals heavy infection, and 9 equals minimal infection (Tab. 1).

The following data were recorded: trunk cross-sectional area, yield per tree, fruit weight, percentage of fruits greater 7.0 cm in diameter, and percentage of fruits with more than 50% of their surface red. The following data were calculated: eight-year cumulative yield per tree, cumulative yield per hectare, and productivity index of cumulative yield.

Results were elaborated by analysis of variance, followed by Duncan's multiple range t-test at $P = 0.05$. Data expressed as percentages were transformed by the method of Bliss.

RESULTS AND DISCUSSION

The level of scab infection varied widely from year to year. In 2000 and 2001, scab did not infect any of the fruits of any of the cultivars tested. In 2002, scab infected all the fruits of 'Ligol', 'Pilot' and 'Pinova', which means that these cultivars cannot be profitably grown without chemical protection at least in some years. Scab also infected the fruits of 'Redkroft', 'Egeria', 'Medea' and 'Lodel' in some years, but not to the degree where chemical control is

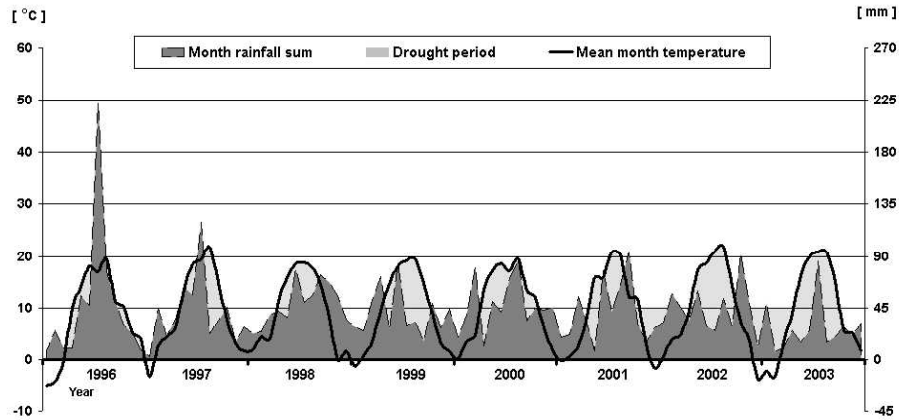

Figure 1. Climatic diagram, Przybroda, 1996-2003

T a b l e 1 . Scale for infection of fruits and leaves by apple scab

Score	Infected fruits [%]	Infected leaves [%]
1	30.0 and more	75.0 and more
3	15.0 to 29.9	35.0 to 74.9
5	7.5 to 14.9	12.0 to 34.9
7	3.0 to 7.4	3.0 to 11.9
9	0.5 to 2.9	0.5 to 2.9
9*	no infection (total resistance)	no infection (total resistance)

necessary for profitable cultivation. In 1999 and 2002, scab infected all of the leaves of 'Ligol', 'Pilot' and 'Pinova'. In the other years, and with the rest of the cultivars, the level of leaves infected with scab varied, but was generally not very high (Tab. 2).

Vigor was expressed by trunk cross-sectional area at the end of the trial, and varied from cultivar to cultivar. 'Ligol' and 'Pinova' were the most vigorous, and 'Medea', 'Egeria' and 'Pilot' were the least vigorous (Tab. 3).

In the second year after planting, the trees started to bear occasional fruits. Yields increased in subsequent years. 'Lodel' and 'Pilot' had the highest cumulative yields, and 'Medea', 'Pinova', and 'Redkroft' had the lowest cumulative yields (Tabs 3 and 4). Kruczyńska (1998; 2002) had reported earlier that 'Lodel' and 'Pilot' were very high yielding cultivars.

According to Rejman (1994), productivity depends not only on the genetics of the cultivar, but also on agrotechnical techniques and the

Table 2. Scab occurrence on fruits of apple cultivars

Cultivar	Scab on fruits					
	1998	1999	2000	2001	2002	2003
'Redkroft'	6.0	9.0	9.0	9.0	8.7	8.8
'Egeria'	9.0	9.0	9.0	9.0	9.0	9.0
'Medea'	6.5	9.0	9.0	9.0	7.1	8.7
'Ligol'	1.5	1.0	9.0	9.0	1.0	9.0
'Lodel'	7.5	9.0	9.0	9.0	8.6	8.8
'Pilot'	6.0	2.0	9.0	9.0	1.0	8.3
'Pinova'	3.0	1.5	9.0	9.0	1.0	8.2
	Scab on leaves					
'Redkroft'	8.0	8.0	9.0	9.0	7.0	7.4
'Egeria'	7.0	8.1	9.0	8.0	5.2	8.2
'Medea'	6.0	9.0	9.0	8.0	4.1	8.0
'Ligol'	1.5	1.0	8.0	5.0	1.0	7.8
'Lodel'	7.0	8.8	9.0	9.0	8.1	7.7
'Pilot'	7.5	1.0	8.5	5.5	1.0	6.9
'Pinova'	3.0	1.0	8.0	5.0	1.0	6.7

Scale from 1 to 9, where 1 equals heavy infection, and 9 equals minimal infection (Table 1)

Table 3. Vigor, yield and productivity of apple cultivars

Cultivar	Trunk cross-sectional area in Autumn, 2003 [cm^2]		Cumulative yield 1996-2003 [kg/tree]		Productivity index of cumulative yield 1996-2003 [kg/cm^2]	
'Redkroft'	20.0	cd*	33.8	a	1.7	ab
'Egeria'	15.5	ab	37.2	ab	2.4	bc
'Medea'	13.5	a	33.2	a	2.5	bc
'Ligol'	22.8	d	41.1	bc	1.8	ab
'Lodel'	19.9	bc	65.0	d	3.3	cd
'Pilot'	16.7	ab	60.8	d	3.6	d
'Pinova'	22.1	d	33.3	a	1.5	a

*Results followed by the same letter do not differ significantly at P = 0.05 according to Duncan's t-test

location of the orchard. The productivity index was calculated as cumulative yield divided by trunk cross-sectional area. 'Pilot' had the highest productivity index, and 'Pinova', 'Redkroft' and 'Ligol' had the lowest productivity indices (Tab. 3).

Table 4. Yield of apple cultivars

Cultivar	Yield [kg/tree]								Cumulative yield 1996-2003 [t/ha]	
	1996	1997	1998	1999	2000	2001	2002	2003		
'Redkroft'	0.5 abc*	1.5 abc	4.6 abc	6.1 ab	4.5 ab	2.0 ab	12.5 cde	2.1 bc	56.3	a
'Egeria'	0.1 a	1.0 ab	4.2 ab	5.9 ab	4.7 ab	5.9 cd	7.7 abc	7.7 cde	62.0	ab
'Medea'	0.3 a	0.9 a	3.6 a	6.7 ab	5.8 bc	0.2 ab	11.6 bcd	4.1 bcd	55.3	a
'Ligol'	1.9 d	3.8 d	8.7 e	2.4 a	10.2 e	3.4 bc	3.8 a	1.2 a	68.5	bc
'Lodel'	1.3 cd	3.0 a-d	8.8 e	13.1 c	8.9 cd	7.2 de	14.9 f	7.8 cde	108.4	d
'Pilot'	0.9 abc	3.2 bcd	5.8 a-d	6.1 ab	6.7 bcd	13.7 e	7.5 abc	16.9 g	101.4	d
'Pinova'	0.6 abc	3.9 d	5.4 a-d	2.8 a	4.0 a	1.6 a	5.8 ab	9.2 def	55.5	a

*For explanation, see Table 3

Table 5. Fruit quality of apple cultivars

Cultivar	Fruit weight mean 1997-2003 [g]		Fruits > 7.0 cm in diameter mean 1997-2003 [%]		Fruits with more than 50% of their surface red mean 1997-2003 [%]	
'Redkroft'	159.0	cd*	78.9	c	85.2	bc
'Egeria'	140.0	ab	72.9	bc	79.8	b
'Medea'	146.5	bc	67.9	ab	78.5	b
'Ligol'	220.9	e	91.0	d	77.3	bc
'Lodel'	136.8	ab	77.5	c	87.4	c
'Pilot'	142.8	ab	59.6	a	89.1	c
'Pinova'	118.7	a	69.4	ab	70.9	a

* For explanation, see Table 3

Fruit weight varied widely from cultivar to cultivar. 'Ligol' had by far the heaviest fruits, which agrees with earlier reports (Ugolik et al., 1996; Szczygieł and Czynczyk, 2002). 'Pinova' had by far the lightest fruits. 'Ligol' had the largest fruits, and 'Pilot' had the smallest fruits. 'Pilot' had the best colored fruits, and 'Pinova' had the worst colored fruits (Tab. 5).

CONCLUSIONS

1. 'Redkroft', 'Egeria', 'Medea' and 'Lodel' were relatively resistant to apple scab and can be grown without chemical protection. 'Ligol', 'Pilot' and 'Pinova' were totally infected with scab in some years, and require chemical protection for profitable cultivation.
2. 'Ligol', 'Pinova' and 'Redkroft' were the most vigorous of the cultivars tested, and 'Medea', 'Egeria' and 'Pilot' were the least vigorous.
3. 'Lodel' and 'Pilot' had the highest eight-year cumulative yield, and 'Medea', 'Pinova', 'Redkroft' had the lowest cumulative yield.
4. 'Ligol' had by far the heaviest fruits, and 'Pinova' had by far the lightest fruits.
5. 'Ligol' had the largest fruits, and 'Pilot' had the smallest fruits.
6. 'Pilot' had the best colored fruits, and 'Pinova' had the worst colored fruits.

REFERENCES

Kellerhals M. 1994. Combining stable disease resistance with high fruit quality and good yielding capacity in apple. NORWEGIAN J. AGRIC SC. (Supplement)17: 39-48.

Kruczyńska D. 1998. Nowe odmiany jabłoni. Hortpress. Warszawa, pp. 88-90.

Kruczyńska D. 2002. Jabłonie nowe odmiany. Hortpress. Warszawa. pp. 80-81.

Krűger J. 1989. Scab resistance of apple cultivars, selections and progenies with the V_f gene. OILB

Working Group “Integrated Control of Pome Fruit Diseases” VOL. II, WPRS BULLETIN XII/6: 161-167.

Pitera E. 1992. Odmiany jabłoni odporne na parcha hodowli Katedry Sadownictwa SGGW oraz ocena ich przydatności do Integrowanej Produkcji Owoców. PRACE ISK, SER. C: 3-4/115-116: 244-246.

Rejman A. 1994. Pomologia. Praca zbiorowa pod redakcją A. Rejmana. PWRiL, Warszawa.

Rouselle G.L., Williams E.B,. Hough L.F. 1974. Modification of the level of resistance to apple scab from the V_f gene. PROC. OF THE XIX INTERN. HORT. CONG, Warszawa 3: 9-26.

Szczygieł A., Czynczyk A. 2002. Suitability of some semidwarf and dwarf rootstocks to three apple cultivars in the subcarpatian region. J. FRUIT ORNAM. PLANT RES. 10: 85-93.

Ugolik M., Lech W., Kulawik K. 1996. Odmiany jabłoni. Plantpress. Kraków. strony?

Walter J., Liegth H. 1970. Imadiagram. Weltatlas, Jena.

OCENA ODMIAN JABŁONI O RÓŻNEJ PODATNOŚCI NA PARCHA (*Venturia inaequalis* ADERH.)

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STRESZCZENIE

Jednoroczne okulanty siedmiu odmian jabłoni o różnej wrażliwości na parcha jabłoni: ‘Redkroft’, ‘Egeria’, ‘Medea’, ‘Ligol’, ‘Lodel’, ‘Pilot’ i ‘Pinova’ na podkładce M.9 posadzono wiosną 1995 w Przybrodzie pod Poznaniem. Dla drzew zastosowano rozstawę 4,0 x 1,5 m. Pominięto ochronę chemiczną przeciwko parchowi jabłoni. Uprawa odmian: ‘Redkroft’, ‘Egeria’, ‘Medea’ i ‘Lodel’ była możliwa bez chemicznej ochrony przeciwko parchowi. Jednak w niektóre lata owoce i liście odmian ‘Ligol’, ‘Pilot’ i ‘Pinova’ były całkowicie porażone przez parcha. Najsilniej rosnącymi odmianami okazały się ‘Ligol’ i ‘Pinova’, a najsłabiej ‘Medea’, ‘Egeria’ i ‘Pilot’. Najwyższym sumarycznym plonem jabłek cechowały się ‘Lodel’ i ‘Pilot’, a najniższym ‘Medea’, ‘Pinova’, ‘Redkroft’ i ‘Egeria’. Najcięższymi owocami odznaczył się ‘Ligol’, a najlżejsze owoce miały ’Pinova’, ‘Lodel’, ‘Egeria’ i ‘Pilot’. Największe jabłka stwierdzono u odmiany ‘Ligol’, a najmniejsze u odmian ‘Pilot’, ‘Medea’ i ‘Pinova’. Najlepiej wybarwionymi jabłkami charakteryzował się ‘Pilot’, a najgorzej wybarwionymi ‘Pinova’.

Słowa kluczowe: jabłoń, odmiana, wzrost, plonowanie, podatność na parcha