of Macspur McIntosh apples in their first 4 years of production. The long-term influence of these rootstocks could not be assessed because the block was removed in 1991.

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Fruit Varieties Journal 48(2):97-100 1994

Susceptibility of 15 Apple Cultivars to Apple Scab, Powdery Mildew, Canker and Mites

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Abstract

Field resistance of 15 apple cultivars to diseases and pests was evaluated by not treating with pesticides during the observation period. The level of apple scab, powdery mildew, canker and fruit tree spider mites was assessed.

The cultivars 'Discovery,' 'Filippa,' and 'Bramleys Seedling' showed low susceptibility to scab. 'Mutsu,' 'Summerred,' 'Gravenstein' and in some cases 'Cox's Orange,' 'Guldborg' and 'Red Ananas' were very susceptible to scab. 'Belle de Boskoop,' 'Bramleys Seedling,' 'Discovery,' 'Filippa,' Ingrid Marie' and 'Mutsu' had low susceptibility to powdery mildew, whereas 'Ildrod Pigeon' was sensitive to powdery mildew. 'Belle de Boskoop,' 'Bramleys Seedling,' 'Filippa' and 'Red Ananas' were not sensitive to canker. 'Discovery' and 'Transparente Blanche' were most susceptible to canker. 'Belle de Boskoop,' 'Cox's Orange,' 'Gravenstein,' 'Mutsu' and 'Skovfoged' had low susceptibility to spider mites. 'Red Ananas,' 'Filippa,' 'Discovery,' 'Guldborg' and 'Ildrod Pigeon' were attacked by spider mites.

Introduction

Efforts to avoid or reduce the use of pesticides are stressed in organic and integrated pest management production systems.

Growing less susceptible cultivars appears to be one of the important factors. Knowledge about the susceptibility of different cultivars is mostly based on grower experience, where the conditions vary, or on research where only one or two pathogens were investigated. The present study was conducted to obtain more complete information about the susceptibility of important cultivars in Denmark under field conditions.

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Materials and Methods

In 1983 15 apple cultivars (Table 1) were planted at the research fields of the Department of Pomologi, Aarslev and at the University of Agriculture, Taastrup. Twelve trees of each cultivars grafted on seedling, MM.106 and M.26 rootstocks were randomized in two blocks on each locations.

Grass alleyways and 1.5 m herbicide strips in the row were established. Row distance was 6 m, and the trees were shaped as bush trees.

The trees were not protected with chemicals against fungal diseases and pests during the observation period.

The level of scab infection on fruits at harvest was assessed on 100 fruits per block. The level of infections of the following was assessed annually in August on a scale of 1 = nothing to 10 = severe: scab *(Venturia inaequalis)*, powdery mildew *(Podosphaera leucotricha)*, canker *(Nectria galligena)* and red spider mite *(Panonychus ulmi)*. Wounds caused by canker were cut clean each winter.

The results were analyzed with the 'General Linear Model (GLM)' method and compared with Duncan's test.

Results

Infections of apple scab did not become severe in 1989 due to dry weather. The mildew, canker and scab infections were larger in 1990 due to hot and not too dry weather special in the spring.

According to the evaluation of scab infection (Table 1), the cultivars can roughly be divided into 3 groups:

1: Cultivars with low susceptibility to scab: 'Discovery,' 'Filippa' and 'Bramleys Seedling.'
2: Cultivars with medium susceptibility to scab: 'Transparente Blanche,' 'Skovfoged,' 'Ingrid Marie,' 'James Grieve,' 'Red Ananas,' 'Ildrod Pigeon' and 'Belle de Boskoop.'
3: Cultivars with high susceptibility to scab: 'Mutsu,' 'Summerred,' 'Gravenstein,' 'Guldborg' and 'Cox's Orange.'

Table 1. Evaluation of 15 apple cultivars for susceptibility to apple scab. Percent fruits without scab and rating for scab infection on two locations.

		Percent fruits without scab		Score for scab infection (1-10)	
Cultivar	Location	1	2	1	3
'Discovery'		95 a	76 abc	1.4 h	1.0 d
'Filippa'		91 a	91 a	1.8 gh	1.7 cd
'Bramleys Seedling'		81 b	88 a	2.0 g	1.3 cd
'Red Ananas'		78 bc	35 de	3.3 ef	5.0 ab
'Belle de Boskoop'		72 cd	71 abc	2.9 f	1.7 cd
'Transparente Blanche'		70 cd	—	4.3 c	—
'Skovfoged'		71 cd	49 bcd	2.9 f	2.0 cd
'Ingrid Marie'		58 e	87 a	3.0 f	1.7 cd
'Ildrod Pigeon'		63 de	80 ab	3.7 d	2.0 cd
'James Grieve'		57 e	80 ab	3.4 de	1.7 cd
'Guldborg'		45 f	58 bcd	4.3 c	2.0 cd
'Cox's Orange'		47 f	41 cd	3.6 de	2.3 bcd
'Gravenstein'		39 f	77 ab	4.3 c	5.0 ab
'Summered'		21 g	5 e	6.4 a	6.7 a
'Mutsu'		15 g	0 e	4.7 b	7.0 a

Numbers followed by the same letter in columns do not differ significantly for $P \leq 0.05$.
1) Location Aarslev 1988-1990.
2) Location Taastrup 1990.
3) Location Taastrup 1987, 1989, 1990 (on fruits).

Table 2. Infections* of powdery mildew, canker and fruit tree red spider mites of 15 cultivars. Average of 1988-1990, location Aarslev.

	Powdery mildew	Canker	Spider mites
'Belle de Boskoop'	1.0 f	1.3 def	1.7 ef
'Bramleys Seedling'	1.0 ef	1.1 f	2.2 d
'Cox's Orange'	1.9 b	1.7 bcde	1.9 def
'Discovery'	1.1 ef	2.4 a	3.1 c
'Filippa'	1.1 def	1.1 f	3.9 b
'Gravenstein'	1.6 bc	1.8 bcd	1.7 ef
'Guldborg'	1.7 b	1.6 bcdef	3.0 c
'Ildrod Pigeon'	3.1 a	1.9 abc	3.0 c
'Ingrid Marie'	1.3 def	1.6 bcdef	2.0 de
'James Grieve'	1.4 cd	1.9 abc	2.1 d
'Mutsu'	1.1 def	1.8 bcde	1.6 f
'Red Ananas'	1.3 de	1.3 ef	4.3 a
'Skovfoged'	1.9 b	1.9 abc	1.9 def
'Summerred'	1.6 bc	1.5 cdef	2.1 de
'Transparente Blanche'	1.7 bc	2.1 ab	2.1 de

*Rated on a scale 1-10, 1 = no infection.
Numbers followed by the same letter in columns do not differ significantly for $P \leq 0.05$.

Assessing fruit free of scab or rating the level gave nearly identical results, however some variations exits depending upon year and location.

The level of powdery mildew, canker and fruit tree red spider mite infection for the 15 cultivars is presented in table 2.

Only 'Ildrod Pigeon' had a significant infection of mildew (Table 2). Otherwise the level was low and the difference rather small. 'Discovery' had the highest and 'Bramleys Seedling' and 'Filippa' the lowest incidence of canker but the differences were small. The cultivars 'Red Ananas,' 'Filippa,' 'Discovery,' 'Guldborg' and 'Ildrod Pigeon' were susceptible to fruit tree red spider mite. Infection by aphids was too low to report.

Table 3. Susceptibility of 15 apple cultivars to scab and powdery mildew compared to results of other researchers.

Cultivar	Scab	Powdery mildew
'Belle de Boskoop'	Low (4, 5) Medium (0, 2, 3)	Low (0, 4, 11)
'Bramleys Seedling'	Low (0, 3, 5, 12)	Low (0, 8, 10, 12)
'Cox's Orange'	Low (5) Medium (2, 3) High (0)	Medium (0, 8, 10) High (6, 7)
'Discovery'	Low (0, 5) Medium (2, 12)	Low (0, 6, 7, 8, 12)
'Filippa'	Low (0, 5)	Low (0, 10)
'Gravenstein'	Low (12) Medium (1) High (0)	Low (1, 12) Medium (0) High (10)
'Guldborg'	Low (5) High (0)	Medium (0) High (10)
'Ildrod Pigeon'	Medium (0, 5)	High (0, 12)
'Ingrid Marie'	Low (5) Medium (0, 2)	Low (0) Low-Medium (10)
'James Grieve'	Low (5) Medium (0, 2, 4)	Low (0) Medium (13)
Mutsu'	Medium (1, 12) High (0, 2, 5)	Low (0, 12) Medium (1)
'Red Ananas'	Low (5) Medium (0)	Low (0)
'Skovfoged'	Medium (0)	Medium (0)
'Summerred'	Medium (1) High (0, 5, 12)	Medium (0, 1, 12)
'Transparente Blanche'	Medium (0, 1)	Medium (0, 1) High (10)

L = Low susceptibility; M = Medium susceptibility; H = High susceptibility.
1-13 referring the number of the literature in the literature list.
0 = present study.

Discussion

The susceptibility of the 15 cultivars to scab and powdery mildew are compared to the results of other researchers (Table 3). Observations on susceptibility to canker is in agreement with studies in Germany (9) and in Poland (13). However, these results included only 6 of the cultivars in the present study.

The authors do not always agree about the susceptibility of different cultivars. Especially in the cultivars 'Cox's Orange' and 'Gravenstein' there are variations between the informations. The investigators of 'Bramleys Seedling' and 'Filippa' agree that these cultivars are rather low susceptible. 'Mutsu' and 'Summerred' seem to be susceptible to scab everywhere.

Conclusions

This study showed that 'Discovery', 'Filippa' and 'Bramley's Seedling' had the lowest susceptibility to scab and mildew. But 'Discovery' is susceptible to canker and 'Filippa' and 'Discovery' are susceptible to spider mites. For that reason these cultivars are not perfect to grow in low pest management systems. Breeding is the best way to generate healthy cultivars with low susceptibility or resistance to pests.

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