EVALUATION OF APPLE CULTIVARS' RESISTANCE TO APPLE SCAB (*Venturia inaequalis* Che.)

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A B S T R A C T

One-year-old scab resistant apple trees, without feathers, of eight apple cultivars and clones, were planted on M9 rootstock in the spring of 1995 in an orchard in Przybroda near Poznań. The genotypes used were cultivars: 'Novamac', 'Sawa', 'Odra', 'Freedom', 'Florina', 'Free Redstar' and 'Melfree', and U 1165 clone. The trees were spaced at 4.0 x 1.5 m. No chemical protection against apple scab was applied. The most vigorous cultivars were 'Odra' and 'Florina', but the least was 'Novamac'. The highest total fruit yield was obtained from 'Florina' and the lowest from 'Novamac. 'Sawa' yielded the heaviest and largest fruits as opposed to 'Novamac', which yielded the lightest and smallest. The most attractively coloured fruits were from 'Odra' and the least attractive from U 1165.

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

INTRODUCTION

One of the main problems in apple cultivation is the effective protection against apple scab disease, caused by the fungus *Venturia inaequalis* (Mac Hardy, 1996). The goal of breeders is to obtain cultivars with both good production values and resistance to scab (Krüger, 1989; Kellerhals, 1994). In Poland, as well as in other countries, research and breeding programs have been carried out over a number of years to obtain new scab resistant apple cultivars (Rouselle et al., 1974; Pitera, 1992; Meszka and Masny, 2006). There are many scab resistant apple cultivars available. However, it should be pointed out that the majority of them did not come up to the expectations of growers and subsequently affected the consumer market; the reasons having been low yield and low fruit quality, particularly taste.

The aim of this experiment was to estimate the growth, yield and fruit quality of seven scab resistant

apple cultivars and one clone. This was carried out in the Wielkopolska region under conditions where no protection against apple scab was administered.

MATERIAL AND METHODS

The experiment was conducted in an orchard at the Experimental Station in Przybroda, belonging to the Pomology Department of the Agricultural University in Poznań. One-year-old scab resistant apple trees, without feathers, were planted on M9 rootstock in the spring of 1995. The cultivars used were: 'Novamac', 'Sawa', 'Odra', 'Freedom', 'Florina', 'Free Redstar' and 'Melfree', and U 1165 clone (Tab. 1). The trial was established on heavy brown podzolic soil, derived from post-glacial class IIIa clay. Trees were spaced in rows at 1.5 m apart, whereas the distance between rows was 4.0 m (equivalent of planting density 1,667 trees/ha). The apple tree canopies were formed as a spindle. Agricultural practices followed guidelines for commercial apple orchards and plant protection was carried out according to the current recommendations of the Orchard Protection Programme, but there was no chemical protection administered against scab. Each cultivar evaluated comprised of 12 trees, which were distributed evenly on 4 plots each containing 3 trees.

The following data were recorded: trunk cross-sectional area (in cm^2); yield per tree (in kg); mass of fruit (in g); fruit having more than 7.0 cm in diameter (in %); fruit showing more than 50% red coloured skin (in %). Based on these, the following indices were calculated: total fruit yield (kg /tree); total fruit yield (t/ha); productivity index of total yield (kg/cm^2).

Data were transformed following the Bliss function and statistically elaborated using analysis of variance. The significance of differences between means was evaluated using Duncan's multiple range t-test at $P \leq 0.05$.

RESULTS AND DISCUSSION

The vegetative growth, expressed as the final trunk cross-sectional area, varied between cultivars (Szklarz, 2004a). After 11 years of growing, 'Odra' and 'Florina' had the greatest trunk cross-sectional areas (TCSA) and the smallest 'Novamac'. Those that showed intermediate growth vigour were: 'Freedom', 'Free Redstar', U 1165, 'Melfree' and 'Sawa' (Tab. 2). This is in agreement with results obtained by Kruczyńska (1998; 2002), who evaluated 'Florina' as a vigorous cultivar and 'Novamac' as a weak growing one.

Cropping started in the second year after planting (1997), yielding only single fruits. However, this generally increased during the following year. The following comparisons of yield were observed during subsequent years.

(1996-1997). The best yielding cultivar was 'Florina' as opposed to 'Freedom' and 'Novamac' which were the worst.

(1998-2001). 'Florina' produced the best yield as opposed to 'Novamac', with the worst.

Table 1. Origin of scab resistant apple cultivars

Cultivar or clone	Country of origin
Novamac	Canada
Sawa®	Poland
Odra®	Poland
Freedom	USA
Florina	France
U 1165	Poland
Free Redstar	USA/Poland
Melfree	Poland

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(2002-2005). The cultivars 'Melfree' and 'Free Redstar' produced the highest yield as opposed to 'Navamac', with the lowest.

The highest total fruit yield for the period 1996-2005 was obtained from 'Florina' and 'Melfree'. 'Florina' was, in the opinions of Rejman (1994) and Szklarz (2004b), a very good yielding cultivar. The lowest total fruit yield during this period was obtained from 'Novamac' (Tab. 2 and 3). Rejman (1994), maintained that cultivar productivity depends not only on genetic characteristics but also agricultural treatments and the specificity of the site.

The productivity indexes, expressed as total yield in kg per cm^2 of the trunk cross-sectional area, were the highest for 'Freedom' and 'Free Redstar'. Productivity indexes obtained for 'Odra' and 'Sawa' were the lowest (Tab. 2).

Fruit mass varied significantly between cultivars. 'Sawa' had the heaviest fruits. The lightest apples came from 'Novamac'.

'Sawa' produced the highest percentage of fruit having more than 7.0 cm in diameter as opposed to 'Novamac' with the lowest. Rejman (1994) and Ugolik et al. (1996) had recorded similar results. All cultivars tested produced more than 60% of fruits with more than 50% red skin surface. The highest percentage of fruits having more than 50% red skin surface was produced by 'Odra'. The most attractively coloured fruits were produced by U 1165 (Tab. 4).

CONCLUSIONS

1. 'Odra' and 'Florina' were the most vigorous cultivars. 'Novamac' was the least vigorous.
2. The highest total fruit yield for ten years was obtained from 'Florina' and the lowest from 'Novamac'.
3. The highest productivity indexes were from the cultivars 'Freedom' and 'Free Redstar' with 'Odra' and 'Sawa' having the lowest.
4. 'Sawa' had the heaviest and the largest fruits. 'Novamac' however, produced the lightest and smallest apples.
5. The most attractive coloured fruits were from 'Odra' and the least attractive from U 1165.

Table 2. Growth and productivity indices of apple cultivars tested

Cultivar or clone	TCSA* in autumn 2005 [cm^2]	Total fruit yield 1996-2005 [t/ha]	Productivity index 1996-2005 [kg/cm^2]
Novamac	23.1 a**	138.7 a	3.6 ab
Sawa	36.0 bc	167.0 ab	2.8 a
Odra	47.3 c	202.4 bc	2.6 a
Freedom	26.5 ab	192.8 ab	4.4 c
Florina	44.8 c	237.5 c	3.2 ab
U 1165	29.7 ab	199.9 bc	4.0 bc
Free Redstar	28.2 ab	203.2 bc	4.3 c
Melfree	33.4 bc	226.0 c	4.1 bc

*Trunk cross-sectional area
**Means followed by the same letter do not differ significantly at P≤0.05; Duncan's multiple range test

Table 3. Yielding of apple cultivars tested

Cultivar or clone	Yield of fruits [kg/tree]			
	1996-1997	1998-2001	2002-2005	total fruit yield 1996-2005
Novamac	2.9 a*	27.3 a	53.0 a	83.2 a
Sawa	3.5 ab	31.6 ab	65.0 ab	100.1 ab
Odra	4.3 b	38.0 ab	79.1 bc	121.4 bc
Freedom	2.7 a	38.5 ab	74.5 bc	115.7 ab
Florina	7.7 c	52.0 c	82.8 cd	142.5 c
U 1165	4.2 b	45.7 bc	70.0 ab	119.9 bc
Free Redstar	3.2 ab	31.1 ab	87.6 d	121.9 bc
Melfree	4.2 b	37.3 ab	94.1 d	135.6 c

*Means followed by the same letter do not differ significantly at P≤0.05; Duncan's multiple range test. Analysis of variance was made separately for each period of yielding

Table 4. Fruit quality indices of apple cultivars tested

Cultivar or clon	Mass of fruit 1998-2005 [g]	Percentage of fruit with diameter > 7.0 1998-2005	Percentage of fruit with coloured skin surface > ½ 1998-2005
Novamac	125.3 a*	62.6 a	83.4 bc
Sawa	184.2 c	93.7 c	74.5 ab
Odra	144.8 ab	76.8 ab	92.0 c
Freedom	175.0 bc	87.7 bc	77.1 ab
Florina	152.3 ab	76.4 ab	85.6 bc
U 1165	176.1 bc	84.2 bc	62.1 a
Free Redstar	160.2 bc	71.0 ab	73.8 ab
Melfree	153.8 ab	71.2 ab	77.4 ab

*Means followed by the same letter do not differ significantly at P≤0.05; Duncan's multiple range test. Analysis of variance was made separately for each variable

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OCENA ODMIAN JABŁONI ODPORNYCH NA PARCHA JABŁONI (*Venturia inaequalis* Che.)

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S T R E S Z C Z E N I E

Jednoroczne okulanty ośmiu parchoodpornych odmian i klonów jabłoni: ‘Novamac’, ‘Sawa’, ‘Odra’, ‘Freedom’, ‘Florina’, U 1165, ‘Free Redstar’ i ‘Melfree’ na podkładce M.9 posadzono wiosną 1995 roku w Przybrodzie pod Poznaniem. Dla drzew zastosowano rozstawę 4,0 x 1,5 m. Pominięto ochronę chemiczną przeciwko parchowi jabłoni. Najsilniej rosnącymi odmianami okazały się ‘Odra’ i ‘Florina’, a najsłabiej rosnącą – ‘Novamac’. Najwyższym sumarycznym plonem jabłek cechowała się ‘Florina’, a najniższym – ‘Novamac’. Najcięższymi i jednocześnie największymi owocami odznaczyła się ‘Sawa’, a najlżejsze i najmniejsze owoce miała odmiana ’Novamac’. Najlepiej wybarwionymi jabłkami charakteryzowała się ‘Odra’, a najgorzej klon U 1165.

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