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Evaluation of several dessert cultivars of plum, new under climatic conditions of Poland

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Abstract

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An experiment was established in the spring of 2006 in the Experimental Orchard in Dąbrowice (central Poland). The plum cultivars under assessment included: 'Avalon', 'Edda', 'Excalibur', 'Jubileum', 'Mallard' and 'Reeves'. Trees of the cv. 'Victoria' were the control combination. On the basis of the eight-year study it was found that the most vigorously growing were trees of the cultivar 'Excalibur'. The most susceptible to frost damage and infection by *Chondrostereum purpureum* (silver leaf) were trees of the cultivars 'Edda' and 'Excalibur'. In addition, the cv. 'Excalibur' was characterized by high susceptibility to the *Plum pox virus* (sharka). The highest cumulative fruit yield was shown by the cultivar 'Jubileum'. The worst fruiting were trees of the cultivar 'Mallard'. Fruits of the cv. 'Excalibur' had the highest weight. The smallest were fruits of the cv. 'Edda' characterized by early ripening time. The highest amounts of soluble solids were contained in fruits of the cultivar 'Avalon'. The cvs 'Edda', 'Reeves' and 'Avalon' proved suitable for cultivation in Polish climatic conditions.

Keywords: tree health status; growth; yield; fruit quality; soluble solids

The plum is a fruit species commonly grown in Poland. The area under plum cultivation is more than 18,000 ha, and about 100,000 tonnes of plums are harvested annually (FAOSTAT 2013). Until the end of the 20th century, most of the 9 million plum trees were grown in extensive orchards and home gardens. In the 1980s, plum cultivation was dominated by cultivars such as: 'Węgierka Zwykła', 'Stanley', 'Węgierka Łowicka', 'Renkloda Ulena' and 'Brzoskwiniowa'. In the winter 1986/87 the temperature fell down below minus 30°C and caused death of nearly 30% of plum trees. A thorough modernization of plum orchards followed. In order to improve the profitability of production, the number of trees planted per unit area was increased, which was enabled by using the cultivar 'Węgierka Wangenheima' (Wangenheim Prune) as a rootstock in new orchards. New valuable cultivars were also introduced, originating mainly from Canada ('Valor', 'Verity'), the USA ('Bluefre', 'Empress', 'Oneida', 'Amers'), the former Yugoslavia ('Cacanska Rana', 'Cacanska Lepotica', 'Cacanska Najbolja', 'Valjevka'), and from Poland ('Węgierka Dąbrowicka') (Grzyb, Rozpara 1998; Hodun et al. 1998). Many of them are still recommended for establishing new commercial orchards in Poland. In recent years, there has been however a decline in interest in the production of plum fruits for processing, with a simultaneous increase in the demand for dessert plums. Valuable dessert varieties of *Prunus domestica* (L.) have been obtained, for example, in England (Jones 1989), Norway (Hjeltnes 1994), Sweden (Vangdal et al. 2007 cit. in Werlemark 1995), and Canada (Vangdal et al. 2007 cit. in Anderson, Okie 1997). Some have been successfully grown for many years in the Nordic countries, while others, from more recent breeding programmes, are becoming increasingly popular (Redalen 2002; Meland, Moe 2007; Sekse 2007; Meland 2010). There is a chance that they will also

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find a place in plum orchards in Poland. Different climatic, soil and economic conditions often cause a cultivar enjoying high reputation in one country to fail in another. For this reason, it is very important to conduct detailed studies in each country before recommending new varieties for large-scale cultivation (Hodun et al. 1998; Rozpara, Grzyb 1998, 2007; Blažek, Pištěková 2009, 2012).

The aim of this study was to assess frost resistance, disease susceptibility, tree growth vigour and yielding, and fruit ripening time and quality of six foreign cultivars of *Prunus domestica* L. in the climatic conditions of central Poland.

MATERIAL AND METHODS

The experiment was established in the spring of 2006 in the Experimental Orchard in Dąbrowice near Skierniewice (central Poland). The average total annual precipitation in this region was 538 mm, and the average annual temperature was 8.6°C. The cultivars under assessment included: 'Avalon', 'Excalibur' and 'Mallard' – of English origin, 'Edda'– originating in Norway, 'Jubileum' – of Swedish origin, and 'Reeves' – of Canadian origin. Trees of the cultivar 'Victoria' served as the control. One-year-old maidens of these cultivars of *Prunus domestica*, grafted onto Myrobalan seedlings, were planted at a spacing of 4.3 × 2.5 m on a podzolic soil with a subsoil of clay. The experiment was designed as randomized blocks in four replications with three trees per plot (a total of 12 trees in each combination). In the first two years, the entire area of the orchard was maintained as mechanical fallow. From the third year, herbicide fallow was maintained in the tree rows, while the inter-rows were grassed over and mowed several times during the growing season in subsequent years. The trees were watered with a drip system. The crowns of the trees were trained in the form of a spindle. Plant protection and agro-technical treatments were performed in accordance with the recommendations for orchards with integrated production.

Each year, using the meteorological station located in the Experimental Orchard in Dąbrowice, data on weather conditions were collected in order to assess their impact on tree health and yielding, and on fruit quality (Table 1).

Frost damage to trees was evaluated on a 1–9 point scale, where: 1 – means withering or withered trees; 3 – trees with extensive damage, individual limbs withering, bark on the trunks and limbs heavily cracked and flaking in large patches, and symptoms of the leaves becoming smaller, yellowing and falling off; 5 – trees with clear symptoms of damage, withering annual shoots, large spots of discoloured bark, cracked bark peeling and falling off in small patches, symptoms of the leaves becoming smaller, yellowing and falling off; 7 – trees with minor injuries, a few small discolorations of the bark on the shoots and signs of the leaves yellowing; 9 – no symptoms (Perczak 2006). Twice a year – in late June and mid-September, a detailed inspection of the trees for the presence of the *Plum pox virus* (sharka) was carried out. The state of the infected trees was determined visually by a 0–3 point scale for symptoms on the leaves, where 0 – means trees without symptoms; 1 – symptoms in one part of the crown; 2 – symp-

Table 1. Weather conditions in the Experimental Orchard in Dąbrowice in 2006–2013

Year	Temperature (°C)			Precipitation (mm)	
	minimum	maximum	mean	total	daily maximum
2006	–31.60	35.28	8.30	250.8	37.4
2007	–17.07	31.07	8.96	526.8	35.0
2008	–13.17	31.20	9.16	437.6	42.4
2009	–23.03	31.44	8.12	594.2	25.4
2010	–28.07	34.32	7.10	556.4	34.4
2011	–22.32	31.31	8.53	529.4	49.0
2012	–24.85	34.56	8.39	391.8	25.4
2013	–21.38	37.81	8.10	422.8	34.8

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toms on several skeleton branches; 3 – symptoms manifested overall. The symptoms on the fruits were investigated when the consumption maturity was reached. A 0–3 point scale was used, where 0 – means fruits without symptoms, 1 – superficial symptoms without deterioration of the fruit quality; 2 – to 10% of the fruit with sharka symptoms, fruit abscission and low quality for consumption; 3 – over 10% of fruits with pathological changes (Iliev, Stoev 2002). Tree growth vigour was expressed by the thickness of the trunk measured annually in the autumn in a permanently marked place at a height of 30 cm above the grafting union. The measurements were used to calculate the cross-sectional area of the trunk. After the trees had come into bearing, the fruits were harvested annually, separately from each tree, and weighed to determine the yield. The time of fruit ripening was also recorded, and the quality of the fruits was assessed. Mean fruit weight was calculated based on a 2-kilogram sample of fruits taken randomly from each replication. Soluble solids content was measured with an RR 12 hand refractometer. Each sample used to determine soluble solids content consisted of 100 randomly selected fruits. The degree of the adherence of the stone to the flesh was evaluated according to the protocol for distinctness, uniformity and stability tests (2003) on a 1–3 point scale, where 1 – means non –adherent, 2 – semi adherent and 3 – adherent stone.

The results were statistically analysed using analysis of variance in the Statistica 10 program. To assess the differences between the means, Duncan's test was used, adopting a significance level of 0.05.

RESULTS AND DISCUSSION

Tree health status

In 2006–2009, i.e. in the first years after planting the trees, the winters were relatively mild. Several times the temperature dropped below minus 20°C, and yet there was no evidence of frost damage on any trees of the plum cultivars being assessed. A frosty and long winter came in the fourth year of the experiment (2009/2010). In January 2010, the temperature dropped to minus 28.1°C, and temperatures below 0°C persisted until early April 2010. The trees of the assessed cultivars were characterized by a varying degree of resistance to frost. Trees of the cultivar 'Mallard', like those of 'Victoria', did not show any symptoms of damage after that winter (Table 2). The most serious frost damage was observed on the trunks and shoots of 'Edda' and 'Excalibur' trees. Those trees received a score of 5 on a 9-point rating scale. There are no data available in the literature on the sensitivity of these cultivars to frost. Redalen (2002) found, however, damage to 'Mallard' trees grown in Norway. In our experiment, trees of the cultivar 'Mallard' were healthy, with any cracked bark on the trunks and no symptoms of the leaves yellowing and falling off. Trees of the cultivars 'Edda' and 'Excalibur', which were the most extensively damaged by frost, showed severe symptoms of silver leaf disease. The spread of this disease, as reported by Grabowski (1999), is promoted by wounds resulting from, among other things, freezing. The number of trees with silver leaf symptoms is shown in Table 2. This disease did not affect trees of 'Mallard' and 'Victoria', which had not been previously damaged by frost.

Table 2. Health status of 7 plum cultivars grafted on Myrobalan seedlings

Cultivar	Frost damage to the trees**	Number of trees infected by	
		silver leaf	*Plum pox virus*
Avalon	7	3	0
Edda	5	5	1
Excalibur	5	5	5
Jubileum	7	2	3
Mallard	9	0	1
Reeves	7	2	0
Victoria*	9	0	1

*control cultivar; **on a 1–9 point scale, where 1 means withering or withered trees, 9 – no symptoms

Plum pox virus (sharka) is a serious problem in plum production in Poland (Grzyb, Rozpara 1998; Rozpara et al. 2010; Malinowski et al. 2013). In our experiment, the most severe symptoms of the disease were recorded on the trees and fruits of the cultivar 'Excalibur'. Of the 12 trees planted, 5 were severely affected. The symptoms on the leaves were manifested overall and over 10% of fruits were with pathological changes. Sharka was also found on the trees of the cultivars: 'Edda', 'Jubileum' and 'Mallard' (Table 2). High susceptibility of the cultivar 'Edda'

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Table 3. Growth and yield characteristics of 7 plum cultivars grafted on Myrobalan seedlings

Cultivar	TCSA** (cm^2)	Yield (kg/tree)						Total yield 2008–2013	Yield efficiency (kg/cm^2)
		2008	2009	2010	2011	2012	2013		
Avalon	142.4^{b}	1.5^{abc}	1.9^{cd}	13.5^{b}	3.8^{c}	12.2^{a}	20.8^{d}	53.7^{c}	0.378^{c}
Edda	111.5^{cd}	0.6^{cd}	5.1^{b}	7.4^{de}	6.1^{ab}	8.9^{c}	14.3^{e}	42.2^{d}	0.385^{c}
Excalibur	170.0^{a}	1.9^{ab}	2.0^{cd}	6.2^{e}	2.0^{d}	1.2^{d}	27.7^{c}	40.9^{d}	0.242^{d}
Jubileum	92.4^{e}	2.3^{ab}	5.6^{ab}	16.3^{a}	6.8^{a}	10.6^{b}	55.9^{a}	97.4^{a}	1.067^{a}
Mallard	108.4^{d}	$1.4b^{c}$	1.0^{d}	9.2^{cd}	6.5^{a}	7.7^{c}	0.8^{f}	26.5^{e}	0.247^{d}
Reeves	124.5^{c}	0.2^{d}	3.2^{c}	7.3^{de}	4.0^{c}	11.6^{ab}	44.3^{b}	70.5^{b}	0.569^{b}
Victoria*	77.6^{f}	2.5^{a}	6.5^{a}	11.2^{c}	4.9^{bc}	11.9^{ab}	38.6^{b}	75.6^{b}	0.985^{a}

*control cultivar; ** TCSA – trunk cross-sectional area; $^{a–e}$values marked by the same superscript in a column are not significantly different according to Duncan's test at a significance level of 0.05

to the *Plum pox virus* was recorded by Preda et al. (2012) in an experiment conducted in Romania. The occurrence of sharka on 'Jubileum' plum trees was also found in earlier studies conducted in Poland (Rozpara et al. 2010; Malinowski et al. 2013) and also in the Netherlands (Verhoeven et al. 1998), whereas Ogašanović et al. (2006), based on an experiment conducted in Serbia, recognized the cultivar 'Jubileum' as tolerant to sharka. In the available literature, there is no information on the susceptibility of the cultivars 'Reeves' and 'Avalon' to the *Plum pox virus*. In our experiment, there were no symptoms of sharka on the leaves or fruits of these cultivars.

Growth and yielding of trees

Trunk cross-sectional area (TCSA) for the seven plum cultivars is shown in Table 3. Trees of the evaluated cultivars were significantly more vigorous than those of 'Victoria'. After eight years of growth in the orchard, the largest cross-sectional area of the trunk was shown by 'Excalibur' trees. Trees of the cultivar 'Avalon' also grew very strongly, which is consistent with the available literature (Jones 1989; Kemp, Wustenberghs 1998; Meland, Moe 2007).

The first fruits appeared on the trees of the evaluated cultivars in the third year after planting. Over the period 2008–2013, the highest yields were obtained from 'Jubileum' trees (Table 3). The smallest fruit crops were harvested from trees of the cultivar 'Mallard', which does not agree with the results obtained earlier by Meland (2004). In Norway, this plum cultivar is considered to be very productive. The low cumulative yield from 'Mallard' trees grown in Dąbrowice was significantly influenced by the year 2013, when the trees bloomed poorly and almost did not bear any fruit.

Trees of the 'Jubileum' plum reached a higher yield efficiency, expressed in kilograms of fruit per 1 cm^2 of the trunk cross-sectional area (TCSA), in comparison with 'Victoria' trees (Table 3). The yield efficiency obtained for trees of the other cultivars assessed was 2–4 times lower than for trees of the cultivar 'Victoria', which is consistent with the results obtained by other authors (Hjeltnes 1994; Meland, Moe 2007; Meland 2010).

Fruit ripening time and fruit quality

Fruits of the evaluated plum cultivars grown in central Poland (Experimental Orchard, Dąbrowice) ripened within a period similar to that in Belgium and the Netherlands (Kemp, Wustenberghs 1998), but earlier than in the studies conducted in the UK (Jones 1989) and Norway (Meland, Moe 2007; Sekse 2007). The reason for the differences in ripening time were different climatic conditions in these fruit-growing areas. The earliest cultivar was 'Edda', and the latest 'Jubileum' (Fig.1). Fruits of the cultivar 'Jubileum' matured about 7 days earlier than those of the cultivar 'Victoria', which is contrary to the report by Vangdal et al. (2007), who stated after Werlemark (1995) that the fruits of the cultivar 'Jubileum' ripen a week later than those of the cultivar 'Victoria'.

Among the evaluated cultivars, the 'Excalibur' plum produced the largest fruits in each year of the

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Table 4. Fruit weight of 7 plum cultivars grafted on Myrobalan seedlings

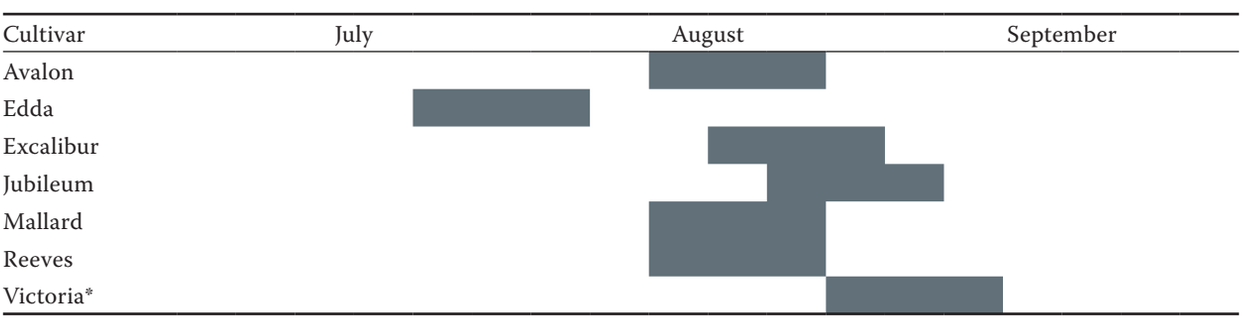
Cultivar	Fruit weight (g)						Mean fruit-weight (g)
	2008	2009	2010	2011	2012	2013	
Avalon	55.3^{d}	49.4^{c}	54.7^{c}	59.1^{b}	51.1^{b}	51.0^{b}	53.4^{c}
Edda	34.9^{g}	33.0^{e}	34.3^{f}	36.3^{d}	34.9^{c}	25.4^{d}	33.1^{f}
Excalibur	78.4^{g}	76.6^{a}	75.7^{a}	68.5^{a}	58.7^{a}	57.6^{a}	69.2^{a}
Jubileum	61.3^{c}	57.8^{b}	48.4^{d}	49.5^{c}	49.6^{b}	54.4^{ab}	53.5^{c}
Mallard	39.6^{f}	32.3^{e}	42.3^{e}	36.0^{d}	37.3^{c}	31.5^{c}	36.5^{e}
Reeves	74.1^{b}	60.2^{b}	69.2^{b}	59.8^{b}	58.8^{a}	52.2^{ab}	62.4^{b}
Victoria*	51.3^{e}	39.2^{d}	42.1^{e}	45.3^{c}	35.3^{c}	25.1^{d}	39.7^{d}

*control cultivar; $^{a–g}$values marked by the same superscript in a column are not significantly different according to Duncan's test at a significance level of 0.05

Table 5. Soluble solids content of 7 plum cultivars grafted on Myrobalan seedlings

Cultivar	Soluble solids content (%)					Mean
	2009	2010	2011	2012	2013	
Avalon	23.7^{a}	20.0^{a}	24.6^{a}	18.2^{a}	20.4^{a}	21.4^{a}
Edda	14.0^{f}	13.9^{d}	14.6^{e}	17.6^{ab}	15.6^{cd}	15.1^{e}
Excalibur	14.9^{ef}	14.3^{d}	15.6^{de}	17.6^{ab}	14.7^{d}	15.4^{e}
Jubileum	21.8^{b}	15.8^{c}	16.9^{cd}	16.1^{c}	16.2^{c}	17.3^{c}
Mallard	19.9^{c}	17.9^{b}	18.4^{b}	17.0^{abc}	18.3^{b}	18.3^{b}
Reeves	15.7^{e}	15.9^{c}	15.0^{e}	16.5^{bc}	15.2^{cd}	15.6^{e}
Victoria*	16.8^{d}	13.9^{d}	17.6^{bc}	17.3^{abc}	16.3^{c}	16.4^{d}

*control cultivar; $^{a–g}$values marked by the same superscript in a column are not significantly different according to Duncan's test at a significance level of 0.05



*control cultivar

Fig. 1. Mean harvest time (2009–2013) of the evaluated cultivars

study (Table 4). Fruits of the cultivars: 'Jubileum', 'Reeves' and 'Avalon' were also larger than those of 'Victoria', which is consistent with results obtained by other authors (Jones 1989; Meland, Moe 2007; Meland 2010). 'Edda' produced the smallest fruits. However, the advantage of this cultivar is early ripening time, good fruit flavour, and non-adherent stone to the flesh.

Soluble solids content, which to a large extent determines the flavour of the fruit, is a cultivar-specific trait, but it also depends on the level of fruit-bearing by trees and on weather conditions. Vangdal et al.

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(2007) obtained a negative correlation between the size of the crop and its quality. Our own results obtained for 'Jubileum' confirm this relationship. An example is the year 2010, when trees of the 'Jubileum' plum yielded the best of all the cultivars tested, but their fruit size and soluble solids content were lower than in the other years of the study (Table 5). According to Kemp and Wustenberghs (1998), soluble solids content at a level of 18–20% almost always guarantees a good taste of the fruit. This is confirmed by our findings, in which the fruits of the cultivars 'Avalon' and 'Mallard', with a high sugar content, were among the tastiest. However, in our study, fruits of the cultivars 'Reeves' and 'Edda' also had a very good taste despite the fact that, like the fruits of the 'Excalibur' plum, they were characterized by markedly lower sugar content (Table 5). The taste depends not only on the sugar content in fruit but also on other features such as, e.g. acid content. In the fruit of the cultivar 'Reeves', the acid content is low, as reported by Vangdal (1985) and Vangdal et al. (2007).

In the case of dessert fruit, in addition to attractive appearance and high taste qualities, non-adherent stone to the flesh is also essential. In this study, 'Edda', 'Mallard;' and 'Jubileum' were freestone. In the case of the 'Reeves', 'Avalon' and 'Excalibur' plums, the separation of the stone from the flesh depended on the year of the study, and was good or moderately good (data not shown). The results of this study are consistent with those obtained by other authors (Jones 1989; Hjeltness 1994).

CONCLUSION

Of the six varieties of *Prunus domestica* (L.), the cultivars 'Edda', 'Reeves' and 'Avalon' are suitable for cultivation in Poland's climatic conditions.

Cultivars 'Reeves' and 'Avalon' are resistant to frost and produce very attractive dessert fruits.

'Edda' is notable for early ripening time and good fruit quality. Because of the low resistance to frost, this plum cultivar can be recommended for growing only in the warmer regions of Poland.

Cultivars 'Jubileum', 'Mallard' and 'Excalibur' are of moderate use for cultivation in Poland. 'Jubileum' and 'Excalibur' plum trees are very sensitive to the *Plum pox virus*. Cultivar 'Excalibur' is also insufficiently resistant to frost, and trees of the 'Mallard' plum are not very prolific.

References

Anderson R.L., Okie D. (1997): Plums. In: Brooks and Olmo Register of Fruit and Nut Varieties. 3rd edition. ASHS Press: 584–627.

Blažek J., Pištěková I. (2009): Preliminary evaluation of new plum cultivars in a dense planting. Horticultural Science, 36: 45–54.

Blažek J., Pištěková I. (2012): Initial results from evaluation of plum cultivars grown in a very dense planting. Acta Horticulturae (ISHS), 968: 99–108.

FAOSTAT (2013): Available at www.faostat3.fao.org

Grabowski M. (1999): Choroby drzew owocowych (Fruit trees diseases). Plantpress. Kraków: 30–31.

Grzyb Z.S., Rozpara E. (1998): Plum production in Poland. Acta Horticulturae (ISHS), 478: 19–24.

Iliev P., Stoev A. (2002): Reaction of some plum cultivars to sharka virus (*Plum pox virus*, PPP-M Strain). Acta Horticulturae (ISHS), 577: 73–77.

Jones R. (1989): Plum Breeding. AFRC Institute of Horticultural Research. Annual Report, 1988: 32.

Hjeltness S.H. (1994): Plum breeding in Norway – past, present and future. Acta Horticulturae (ISHS), 359: 63–68.

Hodun G., Hodun M., Grzyb Z.S. (1998): The promising plum cultivars evaluated in the field collection at Skierniewice, Poland. Acta Horticulturae (ISHS), 478: 193–197.

Kemp H., Wustenberghs H. (1998): Screening of plums and prunes for fresh consumption, 1988–1997. Acta Horticulturae (ISHS), 478: 207–216.

Malinowski T., Rozpara E., Grzyb Z.S. (2013): Evaluation of the susceptibility of several plum (*Prunus domestica* L.) cultivars to *Plum pox virus* (PPV) infection in the field. Sharka-like symptoms observed on 'Jojo' fruit are not related to PPV. Journal of Horticultural Research, 21: 61–65.

Meland M. (2004): High density planting systems of European plums – the effect of growth and productivity of three cultivars after nine years. Acta Agriculturae Scandinavica Section B-Soil and Plant, 2005; 55: 51–57.

Meland M. (2010): Performance of six European plum cultivars on four plum rootstocks growing in a northern climate. Acta Agriculturae Scandinavica, Section B –Soil & Plant Science, 60, Issue 4: 381–387.

Meland M., Moe M.E. (2007): Early performance of four plum rootstocks to six European plum cultivars growing in a Northern climate. Acta Horticulturae (ISHS), 734: 235–240.

Ogašanović D, Trajkovski V., Milinković V., Niketić L. (2006): Performance of new Swedish plum cultivars under the agroecological conditions of Serbia. First EUFRIN Plum and Prune Working Group Meeting. Holovousy (Czech Republic): 173–177.

Perczak J. (2006): Metodyka badania wartości gospodarczej odmian (WGO), odrębności, wyrównania i trwałości (OWT)

doi: 10.17221/38/2016-HORTSCI

roślin uprawnych. Śliwa (Assessment of variety value for cultivation and use (VCU), testing for uniformity, distinctness and stability (DUS) of crops. Plum, Research Centre for Cultivar Testing COBORU Słupia Wielka, II: 1–26.

Preda S., Tarasescu F., Poenaru S. (2012): Plum pox virus impact in Romanian plum production. Acta Horticulturae (ISHS), 968: 181–186.

Redalen G. (2002): Plum growing in Norway, at 60 degrees N. Acta Horticulturae (ISHS), 577: 385–389.

Rozpara E., Grzyb Z.S. (1998): Growth and yielding of some plum cultivars grafted on Wangenheim Prune seedlings. Acta Horticulturae (ISHS), 478: 91–94.

Rozpara E., Grzyb Z.S. (2007): Growth, field and fruit quality of eighteen plum cultivars grafted on two rootstocks. Acta Horticulturae (ISHS), 734: 157–162.

Rozpara E., Głowacka A., Grzyb Z.S. (2010): The growth and yields of eight plum cultivars grafted on two rootstocks in central Poland. Acta Horticulturae, 874: 255–259.

Sekse L. (2007): Plum production in Norway. Acta Horticulturae (ISHS), 734: 23–28.

Vangdal E. (1985): Quality criteria for fruit for fresh consumption. Acta Agriculturae Scandinavica, 35: 41–47.

Vangdal E., Flatland S., Nordbo R. (2007): Fruit quality changes during marketing of new plum cultivars (*Prunus domestica* L.). Horticultural Science, 34: 91–95.

Verhoeven J.Th.J., De Haas A.M., Roenhorst J.W. (1998): Outbreak and eradication of plum pox potyvirus in the Netherlands. Acta Horticulturae (ISHS), 472: 407–412.

Werlemark G. (1995): Jubileum. In: Sortar förädlade vid Balsgard 1943–1994. Institutionen för hortikuturell växtförädling – SLU: 43.

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