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Study of plum cultivars in Norway

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This report presents results of two plum cultivars and selections trials, performed during 2013-2021 and 2016-2021 at Ullensvang.

In total, 19 plum cultivars were evaluated: 4 from the Institute of Horticulture, Čačak, Serbia; 9 cultivars and selections bred by Einar Ruud, Søgne; 3 plum selections from Graminor, Njøs and 1 cultivar from NMBU. Cultivars Opal and Čačanska leptica served as control.

The aim of these reported plum cultivar trials was to investigate recently released plum cultivars and premium selections from Norwegian and Serbian breeding programs from pomological, agronomical, and biochemical point of view, identify the most important quality parameters, and select cultivars with desirable traits for the modern market in Norway.

Based on overall fruit quality and tree productivity, selections NPr. 458 and Anne (R21) (Rudiplomme, if a DNA-test reveal that it is the same as the cultivar Anne (R 21)) are selected for fresh consumption and can be recommended for further commercial growing tests.

Due to very sweet and good fruit taste, cultivars Boranka and Ellen might be used for jam.

LAND/COUNTRY:	Norway
FYLKE/COUNTY:	Vestland
KOMMUNE/MUNICIPALITY:	Ullensvang
STED/LOKALITET:	Lofthus

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Preface

NIBIO Ullensvang is responsible for the official fruit cultivar testing in apple, sweet cherry, plum and pear in Norway. The aim is to find cultivars adapted to Norwegian environmental conditions giving large and annual yields of high quality.

Each year new cultivars are planted in field trials from breeding programs abroad or the Norwegian breeding programs. Pomological characters and fruit quality assessments are evaluated for a period of 7 years.

In this report in total nineteen plum cultivars and advanced selections are described for key characteristics. The field and lab work were done at NIBIO Ullensvang.

The project is funded by The Norwegian Ministry of Agriculture and Food.

Lofthus, 16.01.2023

Mekjell Meland

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1 Introduction

Among stone fruits world production, plums rank second after peach and nectarines and before cherries. Globally, Japanese plum production is greater than the total volume of the European plum production. In 2019, FAO records just over 2,700,000 hectares of plum trees in the world and a total production of about 12,600,000 tons, with an increase of 20% in the last decade (Sottile et al., 2022). China, India, and Serbia are three top producers of plum in the world, followed by Romania, Chile, Iran, USA, Turkey, Italy, France, Ukraine and Spain (FAOStat. 2019). Romania and Serbia are the largest plum producers in Europe, but their production is mainly destined for the internal market and for processing (prunes and spirit), so a very small quantity is exported. Spain and Italy remain Europe's most important suppliers of fresh plums to neighbouring markets, though their plum exports have been declining in recent years (Sottile et al., 2010).

Commercial fruit production in Norway is located in the fjord districts of the southwestern part and around lakes at eastern part of the country at latitude around 60° north and it is a northern border for most of fruit crops (Fotiric Akšić et al., 2022).

According to the national data, annual plum production in Norway during the last decade varied from low 419 t in 2020 till high 2245 t in 2019 (Fig 1). Excluding 2020 year which was not favourite for plum growing due too severe spring frosts, the trend of increasement of locally grown fruits is noticed. Import of plums was relatively stable (approx. 4000 t) during 2012 – 2017, but steady decrease of imported volumes started from 2018. Market share of Norwegian plums was 20-30% during 2012-2018, but reached even more than 40% in 2019 and 2021, when the highest ever yields were recorded. Another reason of increased market share of locally grown fruits is a tendency of lower plum fruit consumption. The consumption of plums was 5000 – 5500 t per year during 2012-2017, so starting from 2018 it decreased till 4700 – 4300 t per year.

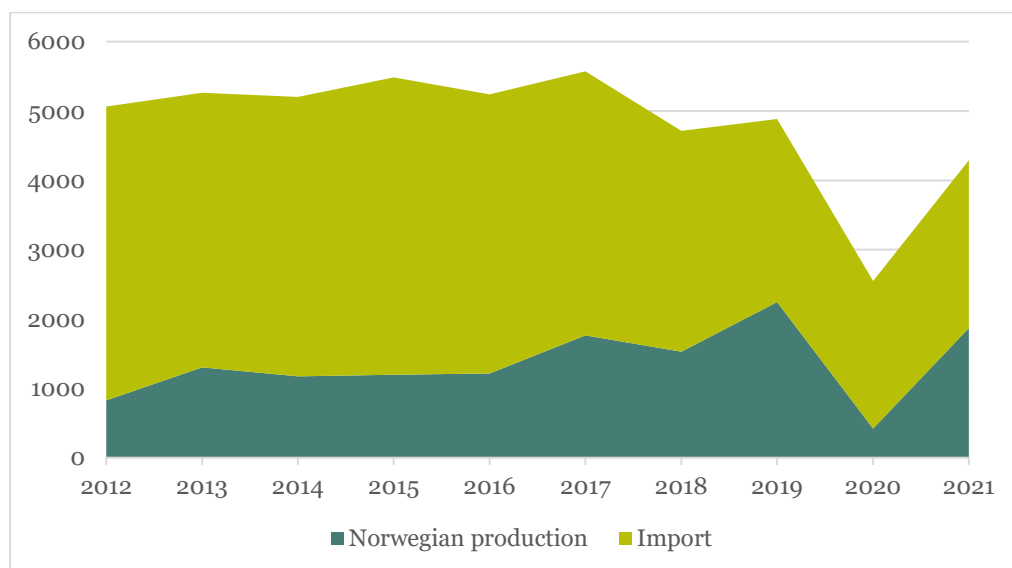


Fig. 1. Market share of domestic plum production and import, ton.

Despite of that many factors such as growing site, rootstock, management technologies, fertilization, irrigation, crop load, harvest time etc., can influence plum orchard growth and fruit quality, fruit productivity in plums, the cultivar is the main factor for successful marketing and gaining a high profitability to plum growers.

NIBIO Ullensvang is responsible for the official fruit cultivar testing in apple, sweet cherry, plum and pear in Norway. Every year new cultivars of fruit crops are propagated and planted in the test field for the scientific evaluation. Under climate change scenario there is a need for improving fruit quality and productivity of plums. For the successful introduction of new plum cultivars, it is important to evaluate various phenological, pomological and fruit quality traits and cultivar adaptation in the local environment.

Plum breeding is carried out in many European countries (Butac et al., 2013). In Norway plum cultivars are bred by Graminor AS, Norwegian University of Life Sciences and private breeders (Hjeltnes et al., 2010). Fruit Research Institute at Čačak Serbia is one of the leading plum breeding centres in the world. Cultivars Čačanska rana, Čačanska lepotica, Čačanska najbolja from their first breeding programmes are well known and commercially cultivated in many countries (Ogašanovic et al., 1994). In the last decade a number of new cultivars resistant or tolerate to *Plum pox virus* and adapted to different climate conditions have been released (Milošević et al., 2019).

The aim of these reported plum cultivar trials was to investigate recently released plum cultivars and premium selections from Norwegian and Serbian breeding programs from pomological, agronomical, and biochemical point of view, identify the most important quality parameters, and select cultivars with desirable traits for the modern market in Norway.

2 Materials and Methods

Two trials of plum cultivars and advanced selections were performed at NIBIO Ullensvang.

The first trial was performed during 2013 – 2021 and included cultivar Ruud and 4 selections performed by the breeder Einar Ruud, Søgne and 3 plum selections from Graminor, Njøs. Experiment orchard was planted in autumn 2013. Trees were propagated on rootstock Wavit and planted as green whips. Planting distance: 2 x 4 m. Each cultivar and selection was replicated 8 – 10 times with one tree per plot. Due to weak performance, selections R5, R24, R25 were grubbed in 2020.

The second trial was performed during 2016 – 2021 and included 4 cultivars (Boranka, Čačanska najbolja, Čačanska rana and Timočanka) bred at the Institute of Horticulture, Čačak, Serbia, 4 cultivars (Ruudiplomme, Søgneplomme, Raud Victoria mutant and Gul Yakima mutant) bred by Einar Ruud, Søgne and cultivar Ellen bred at NMBU. Cultivars Opal and Čačanska lepotica served as controls. All trees were grafted on rootstock St. Julien A and planted in a spring and autumn 2016. Planting distance: 1.5 x 4 m. Each cultivar and selection were replicated 5 – 6 times with one tree per plot.

Trees were trained as free spindle. Pruning was performed in early spring at the dormant stage. Every year trees were thinned to approximately 7 cm between fruitlets late June or early July.

Orchard floor management consisted of frequent mowing of the interrows and a 1 m wide herbicide strip was maintained in the intra-row. All trees received the same amount of fertilizers based on soil and leaf analysis. The trees were fed by an external drip irrigation system geared to provide nutrients through fertigation.

The phenological stages (start of bloom period, 20% of flowers open, full bloom, 80% of flowers open, and harvest dates were assessed every year.

Flowering abundance was evaluated visually in 1-9 scale, where 1 – no flowers, 9 – the highest possible number of flowers.

Increase in trunk growth was assessed annually by measurement of trunk diameter at 25 cm above middle of the graft union of the trees in autumn. Trunk diameter (d) was used to calculate trunk cross sectional area (TCSA) using the formula $TCSA = \pi \cdot (d/2)^2$.

Other plum tree characters as vigour (very weak, weak, medium, strong) and growth habit (upright, spreading, dropping, weeping) were assessed.

The yield (kg/tree) was measured every year and accumulated yield for trial period is presented. Cumulative tree efficiency (kg cm^{-2} TCSA) was calculated dividing accumulated yield by TCSA.

Average fruit weight (g) and fruit diameter (mm) was calculated based on 50 fruit sample per cultivar and year.

Fruit quality characteristics were determined on samples of 50 randomly collected fruits per tree.

Fruit firmness was measured by FirmTech instrument (Bioworks, Stillwater, US). Soluble solid content (%) was measured by Atago® Pallete Digital refractometer PR-101 (Atago®, Tokyo, Japan).

Area over colour (blush) was evaluated visually in 1 - 9 point scale, where 1 – 0% of blush, 9 – 100% of fruit surface is covered by blush.

Fruit colour and fruit flesh colour was described using colour scale.

Bloom of skin was assessed in 9 scale score, where 1 – no bloom, 9 – fruit completely covered by bloom.

Fruit gummosis was assessed in 9 scale score, where 1 – no gummosis, 9 – fruit flesh full of gummosis.

Freestone or clingstone traits depends on fruit ripening stage. Evaluation on this character is given for well ripe fruits and assessed in 9 scale score, where 1 – all fruits are freestone, 9 – all fruits are clingstone.

Fruit taste was evaluated by trained panellists and assessed in 9 scale score, where 1 – uneatable, 9 – excellent taste.

Due to extremely unfavourable weather condition during the blooming time in 2020, there was almost no yield on the trees. Therefore, there is limited data from 2020.

Data was analysed by general analysis of variance (ANOVA) for randomised complete block designs using the statistical program Minitab® 16 statistical software (Minitab Ltd., UK). All main data is presented as an average of six years.

3 Results and Discussions

3.1 Trial 2013. Evaluation of 8 Norwegian plum cultivars and selections

3.1.1 Phenology of flowering

The beginning of plum flowering depended on the year conditions and varied from April 22 in the earliest year of 2019 to May 10. On the average, tested selections begun to bloom on May 03- May 08 (Table 1). Selection NPr. 458 was the latest, but differed significantly only from R21, R24 and R25.

Table 1. Flowering phenology, average 2015-2019 and flowering abundance, average 2017-2019.

Cultivar	Beginning of flowering	Full flowering	End of flowering	Abundance, (1-9)
NPr. 458	May 08 b	May-11 ± 8 c	May 20 c	7.4 ± 0.3 a
NPr. 696	May 06 ab	May-08 ± 8 abc	May 17 bc	5.0 ± 0.9 a
NPr. 894	May 05 ab	May-06 ± 9 a	May 15 ab	6.9 ± 2.2 a
Anne (R21)	May 03 a	May-05 ± 9 a	May 14 a	6.2 ± 2.3 a
R24	May 03 a	May-06 ± 7 a	May 14 a	7.5 ± 1.4 a
R25	May 03 a	May-05 ± 7 a	May 13 a	5.3 ± 2.3 a
R5	May 05 ab	May-07 ± 6 ab	May 16 ab	7.1 ± 1.3 a
Ruud	May 05 ab	May-09 ± 7 bc	May 17 bc	7.3 ± 2.1 a

Values within a column that do not share the same letter are significantly different

Differences of full flowering stage between selections varied on average from May 05 till May 11. Despite of the year conditions, selection NPr. 458 always was the latest to reach full bloom, while R21 and R25 were constantly the earliest (Fig. 2).

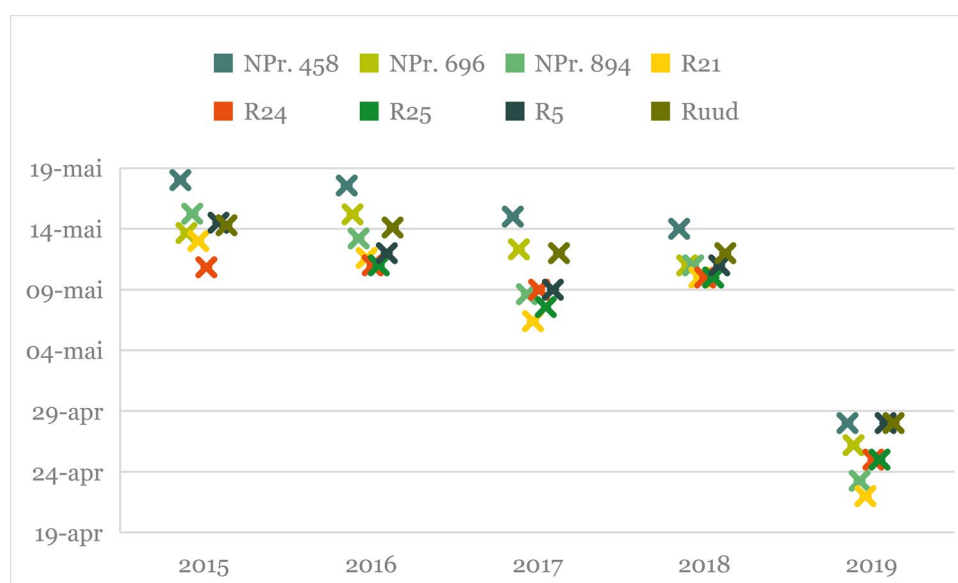


Fig. 2. Variation of full flowering dates.

The average length of flowering period of all tested selections and cultivars lasted 10-12 days. During 5 years of observations the highest variation of the length of flowering period equalled to 4 days and was recorded for NPr. 458, NPr. 696 and Ruud.

Flowering abundance was evaluated in 2017 – 2019, when plum trees reached full production. Though flowering abundance of NPr. 696 and R25 was rated as average and flowering abundance of R24 was rated as high, there were no significant differences established between tested selections and cultivars (Table 1, Fig.2).

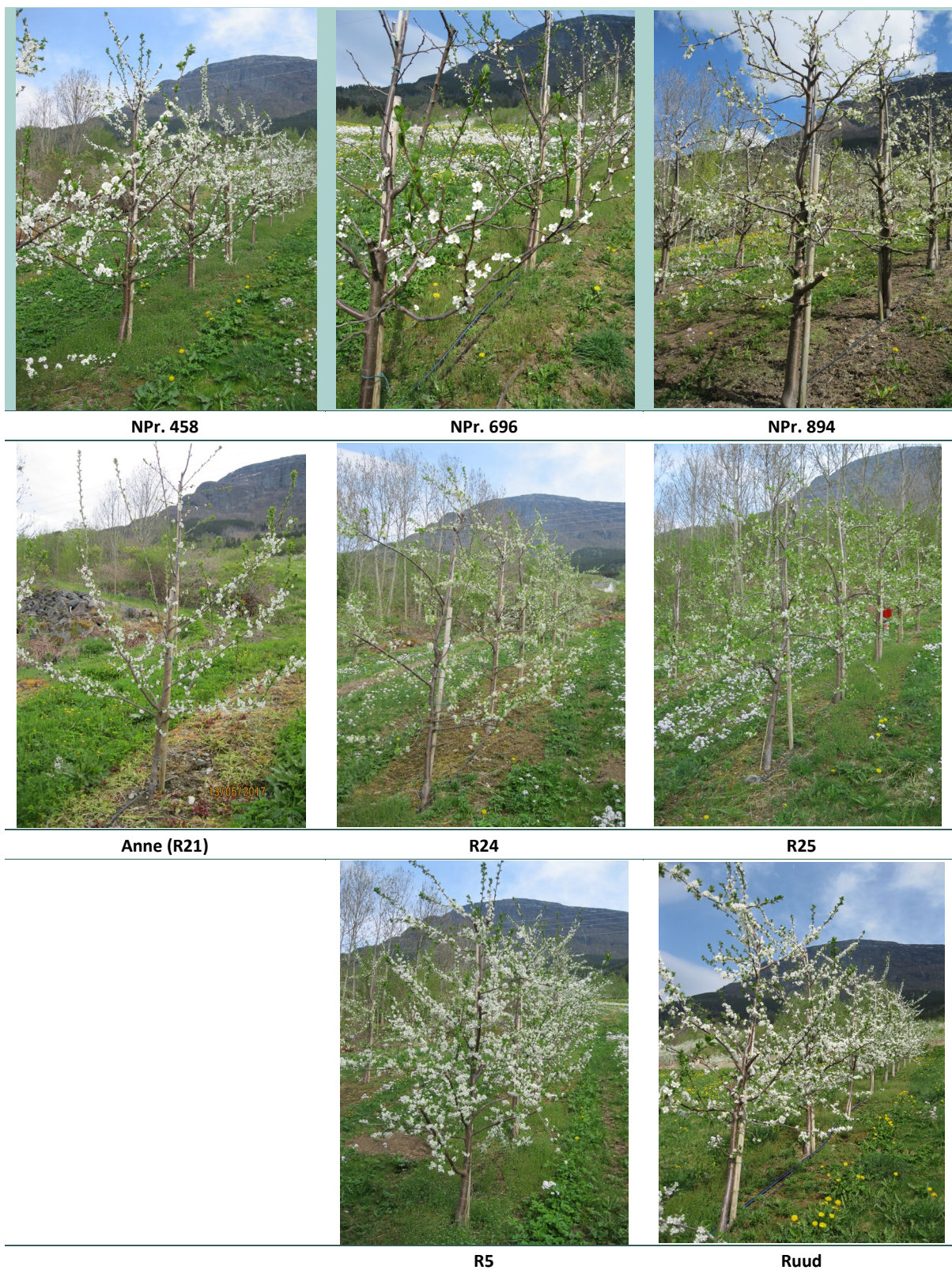


Fig. 3. Pictures of plum selections at full bloom stage. Photos: Oddmund Frøynes, NIBIO

3.1.2 Tree vigour

Plum tree growth was evaluated by the trunk cross sectional area and significant differences were established among tested selections (Table 2). NPr. 894 and R25 grew the most vigorously, while Ruud and NPr. 696 trees were smaller by 30 and 40% respectively. Significant differences of tree growth

were recorded already during the second year in the orchard for the NPr. 696 and during the third year for the Ruud and became even more evident in later years of the trial (Fig. 4).

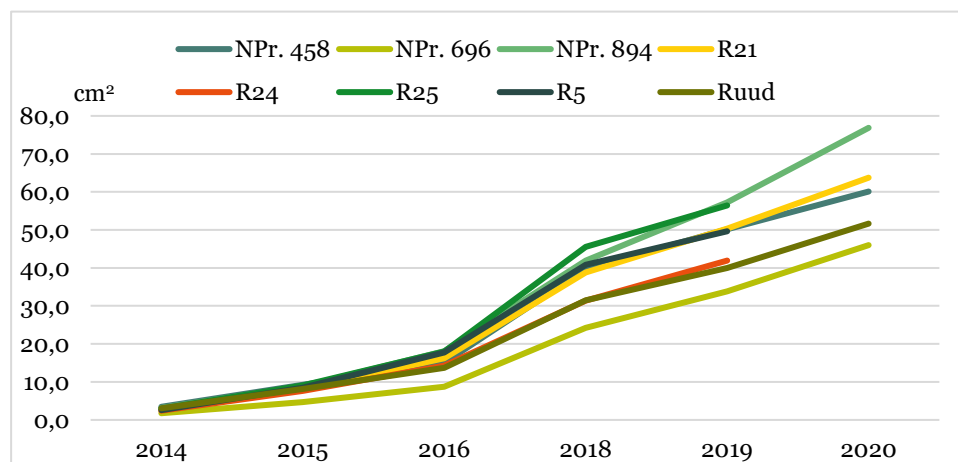


Fig. 4. Tree growth dynamic during 2014-2020, cm² of TCSA (trunk cross sectional area).

3.1.3 Yield and productivity

Evaluation of fruit set revealed significant differences between selections. On the average of 4 years of observations fruit set of R5 and Ruud was high, while fruit set of other selections except NPr. 458 was rated as low (Table 2).

Table 2. Tree vigour, bearing and productivity, average 2016-2019.

Cultivar	TCSA, 2019	Fruit set (1-9)	Cumulative yield, kg/tree	Productivity, kg/cm ² TCSA	Fruit harvest date
NPr. 458	50.1 ab	3.9 ab	29.9 ab	0.60 a	Sep-13 ± 11 d
NPr. 696	33.8 d	2.7 b	8.4 e	0.25 b	Sep-09 ± 8 cd
NPr. 894	57.2 a	2.7 b	16.8 c	0.29 b	Sep-07 ± 8 bc
Anne (R21)	50.3 ab	2.6 b	12.6 d	0.25 b	Aug-22 ± 8 a
R24	41.9 bcd	2.1 b	7.9 e	0.19 c	Sep-09 ± 10 cd
R25	56.4 a	2.1 b	14.2 cd	0.25 b	Sep-13 ± 11 d
R5	49.6 abc	6.0 a	31.2 a	0.63 a	Sep-02 ± 9 b
Ruud	40.0 d	6.1 a	24.6 b	0.61 a	Sep-02 ± 9 b

Values within a column that do not share the same letter are significantly different

R5 and Ruud were the most precocious and started to yield already in the second year after planting and NPr. 458 – in the third year (Fig. 5). Bearing start of the most of other selections was delayed until the fourth year after planting.

Due to precocity and high fruit set, all mentioned selections and cultivar Ruud produced significantly the highest cumulative yield during the first 6 years in the orchard comparing to the rest of selections included into the trial (Table 2). Usually in the young orchard, tree vigour and yield is positively correlated. Some different results were recorded in this trial. The most vigorous R25 and NPr. 894 gave very small yield, when somewhat less vigorous R5 and NPr. 458 cultivars gave the highest yield. The lowest cumulative yield was recorded for R24 and NPr. 696, which has the lowest vigour too.

NPr. 458, R5 and Ruud were the most productive cultivars and significantly differed from the rest in the tested group. Interesting, that NPr. 458 and R5 were between the most vigorous cultivars and Ruud exhibited one of the lowest growth.

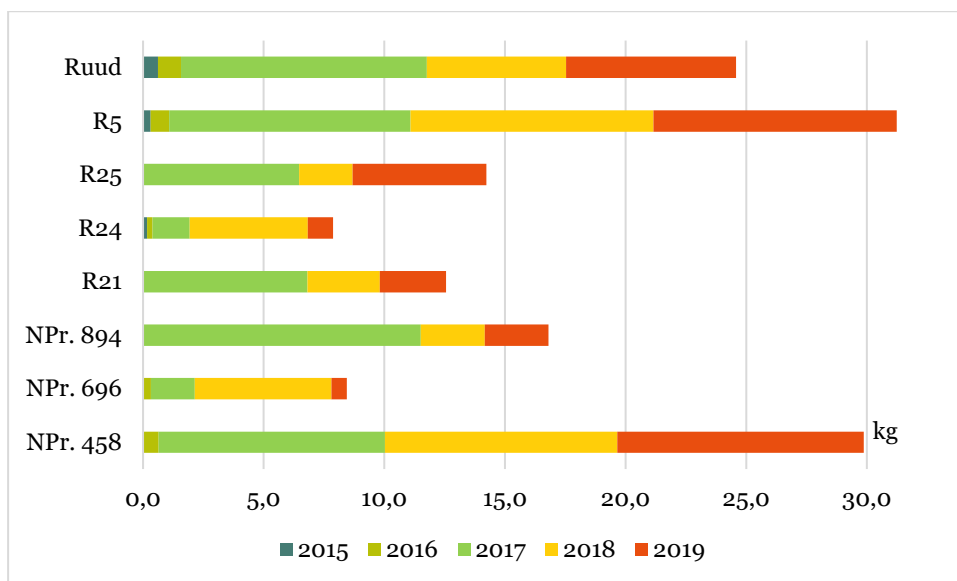


Fig. 5. Precocity and bearing pattern of tested plum selections, kg/tree.

3.1.4 Harvest time

The average harvest time of tested cultivar group in 2018 was Aug.24 (Fig. 6). It was the earliest season and distinguished from other years of observations by 14 – 19 days. Interesting that the harvest time in season 2019 is rated as average, though this season distinguished significantly by the earliest flowering.

Variation of harvest time of separate cultivars during 4 seasons was similar – 18 - 23 days depending on the cultivar.

Anne (R21) was significantly the earliest and R25 and R458 were significantly the latest cultivars in all years of observations (Table 2). Difference of harvest date between the earliest and the latest numbers was 17-18 days in 2016 and 2018, but even 28 days in 2017 and 2019.

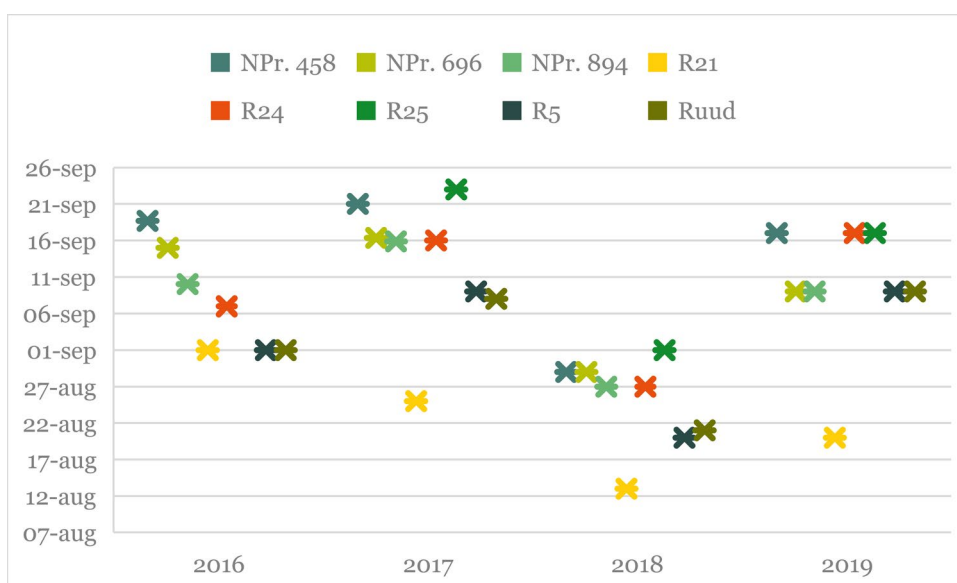


Fig. 6. Variation of harvest dates of tested plum selections.

3.1.5 Fruit quality.

Fruit weight and diameter. The average fruit weight of NPr. 458 and NPr. 894 reached more than 60 g, and weight of R21 overcame 70 g (Table 3). The lowest fruit weight (36 g) was recorded for cultivar Ruud. Fruit weight of tested selections depended on the crop load in particular year, and rather high variation of average fruit weight (± 15 and more grams) was recorded for all three large fruited selections and R25 too.

High tree productivity, which is described by the ratio of tree growth and the yield, resulted that very productive Ruud and R5 produced fruits with low average weight. On another hand, NPr. 458 combined both features – high productivity and the largest fruits.

According to fruit diameter, tested selections formed two distinctive groups. Fruit diameter of all Graminor selections and R21 was around 50 and more millimetres, and significantly differed from fruit diameter of the rest of selections from Søgne, which was less by 6-11 mm.

Table 3. Fruit quality characters, average 2016-2019.

Cultivar	Weight, g	Diameter (mm)	Bloom (1-9)	Gummosis
NPr. 458	61 \pm 17.9 ab	53.7 a	3.2 \pm 1.0 c	1.0 c
NPr. 696	51 \pm 11.1 bc	49.4 b	6.6 \pm 1.1 ab	1.4 bc
NPr. 894	60 \pm 16.5 ab	50.8 ab	4.5 \pm 1.8 bc	2.0 bc
Anne (R21)	71 \pm 15.3 a	51.3 ab	6.9 \pm 2.3 a	2.9 ab
R24	43 \pm 4.8 bc	41.6 c	6.0 \pm 0.5 ab	4.2 a
R25	53 \pm 15.4 abc	44.0 c	4.8 \pm 2.0 abc	1.0 c
R5	44 \pm 7.8 bc	44.9 c	4.3 \pm 1.5 bc	1.0 c
Ruud	36 \pm 9.2 c	44.2 c	4.3 \pm 2.4 bc	1.0 c

Values within a column that do not share the same letter are significantly different

Variation of fruit diameter for selections with the largest fruits is presented in figures 7– 10. Sixty four percent of NPr. 458 fruits were evenly distributed in three size classes between 44 and 50 mm. Share of smaller or bigger fruits was similar. NPr. 894 and Anne (R21) distinguished among other selections that one class was dominating: 41% of NPr. 894 fruits fell into 48-50 mm class, and 42% of Anne (R21) fruits fell into 42-44 mm class. Proportion of larger fruits than dominating class was also greater for both selections than smaller fruits: 36% and 38% versus 24% and 20% respectively. Fruit size distribution of NPr. 696 was the most varying.

Average fruit weight in the same size classes dependent on the plum selection: R21 always had the heaviest fruits, while fruit weight of NPr. 894 was the lowest. For example, the average fruit weight in the same size class 46-48 mm of Anne (R21) was 81 g, NPr. 696 and NPr.458 - 64 g, and NPr. 894 – only 48g.

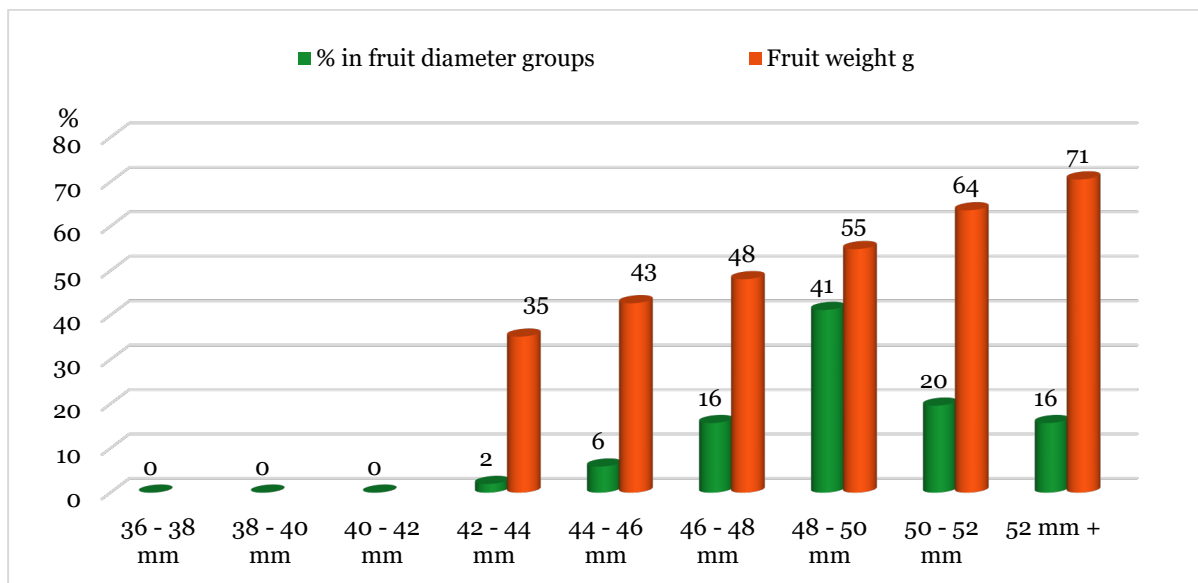


Fig. 7. Grading of plum selection NPR. 894 fruits according to diameter and fruit weight of fruit size groups, 2017.

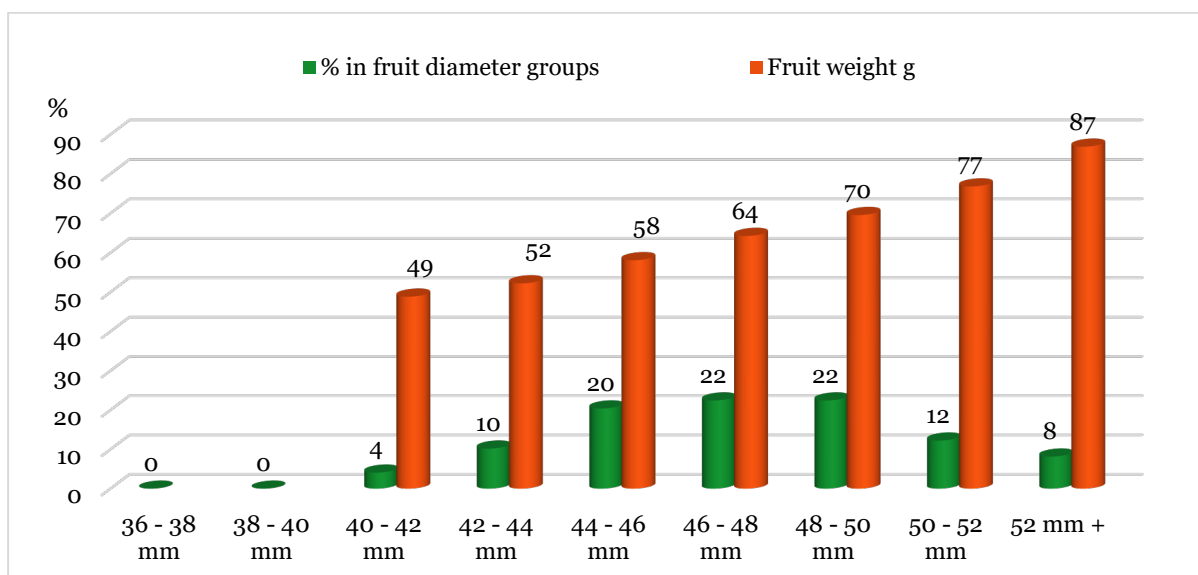


Fig. 8. Grading of plum selection NPR. 458 fruits according to diameter and fruit weight of fruit size groups, 2017.

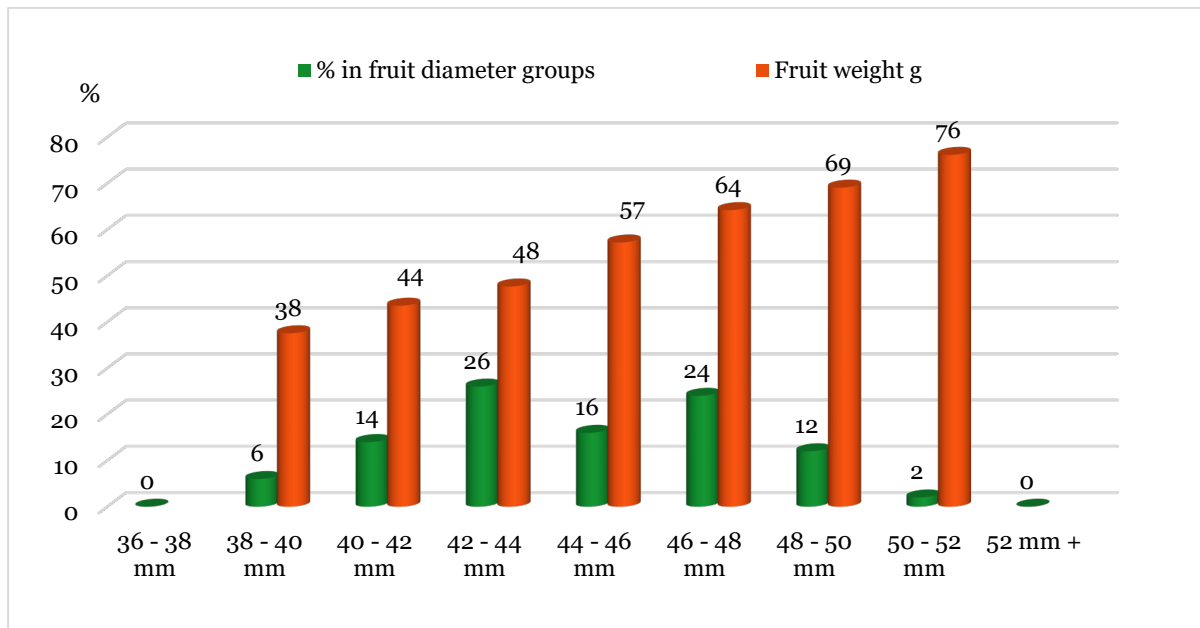


Fig. 9. Grading of plum selection NPr. 696 fruits according to diameter and fruit weight of fruit size groups, 2018.

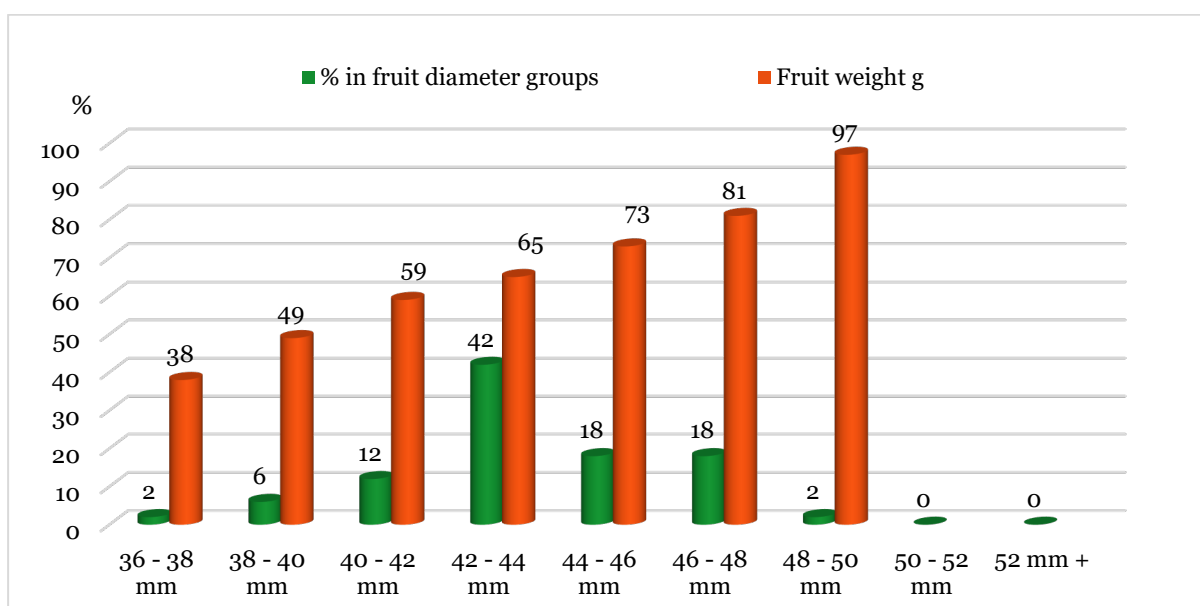


Fig. 10. Grading of plum cultivar Anne (R21) fruits according to diameter and fruit weight of fruit size groups, 2018.

Fruit colour. Most of selections had extensively coloured fruits (Table 4). Blush (over colour) covered 100% of NPr.696 and Anne (R21), around 85-90% of R24 and Ruud fruit surface. NPr. 458 had the least coloured fruits. Red-yellow or yellow with red dots was dominating over colour, and only NPr. 696 and Anne (R21) had red-blue fruits.

Fruit flesh colour was mostly yellow, only NPr. 458 and R5 had yellow-white and NPr. 696 yellow-green coloured flesh.

Table 4. Fruit colour characters, average 2016-2019.

Cultivar	Area of over colour (1-9)	Over colour	Colour of flesh
NPr. 458	5.7 d	red yellow	yellow white
NPr. 696	9.0 a	red blue	yellow green
NPr. 894	7.3 bc	red	yellow
Anne (R21)	9.0 a	red blue	yellow
R24	8.5 ab	yellow with red dots	yellow
R25	6.7 cd	yellow with red dots	yellow
R5	7.0 cd	red yellow	yellow white
Ruud	7.7 abc	red yellow	light yellow

Values within a column that do not share the same letter are significantly different

Fruit firmness is an important fruit quality parameter closely related with fruit storage and consumer preference. NPr. 696 had very firm fruit flesh (Firmtech value 396), as well as NPr. 696 and R25 (Table 5). The lowest flesh firmness was recorded for R5 and Ruud.

Different sugars mostly determined soluble solid content (SSC) in fruits e.g. more sugars higher SSC. SSC varied from high 17.3% in R25 fruits till low 14.3 – 14.5% in R5 and Ruud fruits. Significant differences in SSC were established only between these selections.

Very distinctive differences up to 50% among tested selections were recorded for the acid content - from high 1.37% in Ruud fruits till low 0.78% in NPr. 894 fruits.

Test panel evaluation indicated selections with the best tasting fruits (Table 5). The taste of all Graminor selections and R21 was rated as very good or good. Taste of Ruud fruits did not differ significantly from them, but all other selections from Søgne received lower fruit taste score.

Table 5. Fruit chemical content and taste, average 2016-2019.

Cultivar	Fruit firmness	SSC %*	Acidity %	Fruit taste (1-9)
NPr. 458	333 ± 12.05 bc	15.8 ± 1.73 abc	1.04 ± 0.03 bc	7.8 ± 0.4 a
NPr. 696	374 ± 24.9 ab	16.8 ± 1.30 ab	1.04 ± 0.06 bc	6.8 ± 1.5 ab
NPr. 894	396 ± 46.2 a	15.7 ± 1.86 abc	0.78 ± 0.11 c	7.8 ± 0.4 a
Anne (R21)	323 ± 54.4 bc	15.9 ± 1.87 abc	1.06 ± 0.07 b	7.2 ± 0.7 ab
R24	320 ± 37.9 bc	16.8 ± 0.67 ab	1.20 ± 0.41 ab	5.0 ± 1.2 d
R25	358 ± 37.6 ab	17.3 ± 2.18 a	1.09 ± 0.28 ab	6.0 ± 1.3 bcd
R5	287 ± 22.3 c	14.3 ± 1.56 c	1.31 ± 0.12 ab	5.5 ± 0.8 cd
Ruud	296 ± 44.5 c	14.5 ± 1.75 bc	1.37 ± 0.11 a	6.6 ± 1.1 abc

Values within a column that do not share the same letter are significantly different

* SSC – soluble solid content

3.1.6 Description of cultivars and selections

NPr. 458



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: A cross from Graminor, Njøse by Stein Harald Hjeltnes in 1997. Selected for further testing in 2004.

Parents: Jubileum open pollinated

Ripening time: Late to very late. 6 days after Victoria, but before Valor

Flowering: abundant. Flowering moderate late, 2 days after Opal.

Yield: Trees come quite early into cropping mode. Even though the fruit set has been evaluated to be medium, the yields have been rather high, mainly due to big fruit size. Due to lower temperatures in the late season, a bit uneven ripening development. Normally two harvest times necessary. Should be harvested with the stem to prevent stem attachment from injuries. Annual bearing habit.

Fruit quality: For fresh consumption. Big fruit size 66 g and diameter 53,7 mm. Fruit shape mostly round, slightly oblong. Very nice, illuminating yellow and red colour covering 20-40 % of surface as parts or red spotted skin. Medium thick, somewhat tough skin. Fruit surface covered with very little bloom. Light yellow, nice textured, medium fine-grained fruit flesh. No gummosis within the flesh. Quite firm fruit flesh. 80-90 % freestone fruits. Can crack a bit in the skin after heavy rain. Store well in cold storage – at least for 14 days.

Taste: High soluble solid content and medium acidity gives sweet, balanced, good taste. Almost without any bitter taste and with moderate tartness in the skin. Very good, juicy and fresh but not too tart taste gives a high taste score.

Disease resistance: No essential harming diseases observed. Some fruit rot observed. Some browning in the flesh in 2021 by harvest.

Tree habit /shape /vigour: Upright, vigorous trees. Thick, long branches covered with fruiting spurs.

Drawbacks: The vigorous, upright growing branches is a tree shape that can be challenging to maintain in a central leader tree system.

Conclusion: NPr. 458 is a medium to high cropping selection, demanding moderate thinning. A big sized fruit with yellow-red nice appearance could have potentially a good market appeal. In spite of the yellow-light ground colour, little bruising has been observed. No gummosis within the fruit flesh. Selection NPr. 458 can be recommended for commercial testing.

NPr. 696



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: A cross from Graminor, Njøse by Stein Harald Hjeltnes in 1999. Selected for further testing in 2004.

Parents: Ive x Reeves

Ripening time: Moderate late ripening, simultaneously with Victoria or later.

Flowering: Low. Full bloom 1 day after Opal.

Yield: Trees come medium early into cropping mode. Very low yields. Most of the fruits grow on spurs without leaves. Annual bearing habit.

Fruit quality: For fresh consumption. Big fruit size: 51 g. Fruit shape round, slightly oblong. Skin colour dark blue-red. Fruits gain early the red-blue colour, before the fruit get fully ripen and turns darker. Skin covered with some bloom. Quite thick, tough skin with a distinct bitter taste. Flesh colour yellow-green. Almost no gummosis within the fruit flesh. Fruits can get some rain induced cracking. Very firm fruit flesh. Most years total clingstone fruit and partly freestone (30 %) in one year. Mostly fine-grained texture in the flesh, but white fibre threads in the flesh can occur. Fruits are rather sensitive to a physiological disorder internal breakdown showing flesh translucency and browning in cold store (4 °C) or on the trees when temperatures drop between 2 and 8 °C. Thus, it seems the fruit is quite susceptible to this chilling injury. Fruits that do not get chilling injury, can store well for 14 days.

Taste: High soluble solid content and medium total acidity. The skin taste is quite bitter. Medium juicy and very sweet taste gives a high taste score. Very good Rene Claude d'Oullins-like taste.

Disease resistance: Susceptible to silver leaf disease (breeder's comment) and fruit rot (Monilia)

Tree habit /shape /vigour: Upright, quite strong growing trees. Poor branching and long branches with many bare parts.

Drawbacks: Lack of yields. Ripe fruits showed some rain induced cracking. Susceptible to internal breakdown in cold store.

Conclusion: In spite of very good taste and nice appearance, NPr. 696 is low yielding, susceptible to internal breakdown caused by cold store chilling and have clingstone fruits. Selection NPr. 696 is not recommended for commercial growing.

NPr. 894



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: A cross from Graminor, Njøs by Stein Harald Hjeltnes in 2000. Selected for further testing in 2005.

Parents: Ive x Excalibur

Ripening time: Late, simultaneously with Victoria or later.

Flowering: moderate abundance, 1 day before Victoria.

Yield: Trees come late into cropping mode. Low yield. Moderate amount of bloom and lack of compatible pollen spenders in the vicinity could partly explain the lack of yield. Since the stem is firmly attached to the fruit, it should be harvested with the stem. Annual bearing habit.

Fruit quality: for fresh consumption. Big fruit size 60 g. Fruits with round shape and yellow skin with nice red or red spotted blush. Skin covered most years with medium amount of bloom. Flesh colour yellow-green. Most years, none or moderate gummosis within the fruit flesh observed. One year, firm parts in the fruit flesh. Quite thick, tough skin with a distinct bitter taste. The skin can come off by peeling. Moderate fruit cracking in the skin have been observed. Cracking occurs mostly round the stem and along the suture. Most years, total clingstone fruit, but well ripe fruit could get partly free stone. Very firm fruit flesh, moderate acid and high soluble solid content. Mostly medium grained, ravelled texture in the flesh.

Taste: Taste of the fruit flesh is mild and sweet, but the skin taste quite bitter. Taste receives a high taste score.

Disease resistance: Healthy trees - no tree loss during the test period. Can get some fruit rot (Monilia). No shrinking in the skin above the stem.

Tree habit /shape /vigour: Spreading trees with medium vigour. The first growing years: spiny, dense trees.

Drawbacks: Lack of yields.

Conclusion: In spite of very good taste and nice appearance, selection NPr. 894 is low yielding and is bearing totally clingstone fruit. NPr. 894 is not recommended for commercial growing.

Ruud



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollinated

Ripening time: Ripens along with standard Victoria, uneven maturing, at least two picks.

Flowering: moderate to abundant. Flowering 1 day after Opal.

Yield: Trees come early into cropping mode. Over cropping, probably self-fertile variety. If not thinned early and heavy enough, can get biannual bearing tendency. Due to heavy crops and uneven ripening, at least two picks are needed. Easy pick, can be harvested without stem.

Fruit quality: for fresh consumption and jam. Very Victoria like type of plum. Fruit size is smaller than standard Victoria, but dependent on early and sufficient thinning. Oblong Victoria-shape fruit. The skin colour is nice red-yellow with more red cover than standard Victoria, which by full ripening can cover the whole fruit. Clearly visible lenticels on the skin. Quite coarse, ravelled fruit flesh. First green-yellow, then yellow-white fruit flesh. Medium to considerable amount of bloom on the fruit. Overripe fruits can get soft and flesh translucent in cold store. No gummosis in the flesh. Medium fruit firmness, high total acids and moderate soluble solid content. Totally clingstone fruit. Skin can get some cracking by heavy rain.

Taste: Skin taste medium sour and a bit bitter. Medium juicy flesh. Moderate sweet and a bit tart. The taste can vary from one year to another. Quite good some years, but too weak in other years depending on weather condition, crop load and ripening stage. Overripe fruit do not have acceptable taste.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading – dropping tree habit. Moderate to strong vigour.

Drawbacks: Totally clingstone fruit. Over cropping. Too small fruit size. Varying consumption quality.

Conclusion: In spite of very high crops and nice surface colour, Ruud show no obvious beneficial traits compared to standard Victoria. Even with proper thinning, the fruit obtain only a moderate size. Ruud is not recommended for commercial growing.

R5



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollinated

Ripening time: Ripens along with standard Victoria.

Flowering: Abundant. Flowering time along with Opal.

Yield: Trees come early into cropping mode. High annual crop.

Fruit quality: for fresh consumption and jam. Very Victoria-like type plum. Medium to small fruit size (44 g) like standard Victoria, but dependent on early and sufficient thinning. Oblong Victoria-shape fruit. The skin colour is mottled, nice red-yellow with some more red cover colour than standard Victoria. Can show fruit appearance something between Victoria and Mallard. Quite coarse, ravelled fruit flesh. Quite thin, tough, with moderate bitterness, but tart skin, skinnable. Medium to considerable amount of bloom on the fruit. No gummosis within the fruit flesh. Medium to moderate fruit firmness. Fruits get quite soft if overripe. High acid and moderate soluble solid content. Totally clingstone fruit. Skin can get some cracking by heavy rain. Fruit flesh first green–white, then yellow.

Taste: Skin taste medium sour. Fruit taste is good with proper maturity, but overripe fruit get soft and do not have acceptable taste. Medium juicy flesh. Moderate sweet and a bit tart gives a low taste score.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Upright - spreading. Moderate to strong vigour.

Drawbacks: Totally clingstone fruit. Tendency to crack in rain. Varying consumption quality. Moderate nice appearance.

Conclusion: Despite high crops and acceptable fruit size, R 5 show no obvious beneficial traits compared to standard Victoria. Eating quality is low. R 5 is not recommended for commercial growing.

Anne (R 21)



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollinated

Ripening time: Ripens along with Opal and later. Uneven maturation could demand at least two picks.

Flowering: Abundant and early flowering time.

Yield: Trees come late into cropping mode. Low to moderate annual crop. It is obvious that blooming time for Anne (R 21) most years do not coincide with other potential pollen spenders in the vicinity. The stem is well attached to the fruit, and therefore do not drop easily. Based on this, the fruit should be harvested with the stem. Double fruits can occur some years. Should be harvested on the red-blue maturity stage. Totally blue fruits are overripe. A bit uneven ripening development could demand several picks.

Fruit quality: for fresh consumption and jam. Nice looking, very big 74 g and higher, oblong, red-blue fruit that resembles appearance to Edda and Opal. The colour develops first red and then a more red-blue colour. At the blue stage, the fruit could be overripe. Partly freestone, but the stone get looser by increasing maturity. Thick and tough skin, a bit tart with moderate bitterness. It is skinnable. Fruit flesh is yellow or yellow-orange developing red threads within the flesh by increasing maturity. Quite coarse, ravelled fruit flesh. Considerable amount of bloom on the fruit. Some gummosis within the flesh has been observed almost every year. In addition, some browning within the flesh has been observed in well-ripened fruits one year. Medium fruit firmness, acidity and soluble solid content. Well ripe fruits can get a bit soft. Almost no skin cracking by heavy rain observed.

Taste: The taste is mild and very good, also taken into consideration that the skin has some sour and bitter taste. Juicy flesh.

Disease resistance: Trees have been healthy. No tree loss during the test period. Some Monilia rot observed every year. One year some stone cracking.

Tree habit /shape /vigour: Upright growth. Big, vigorous trees.

Drawbacks: Small crops. Early blooming period.

Conclusion: Anne (R 21) stands out with a fruit size and fruit quality that is unique in this maturity window for plums between Opal and Mallard. However, the yields have been rather low almost all testing years. The lack of yields is probably caused by lack of coincident compatible pollen sources in the vicinity. Given that this problem could be solved, selection Anne can be recommended for further commercial growing tests.

R24



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollinated

Ripening time: late, several days after standard Victoria.

Flowering: Abundant. Early flowering time - 1 day before Victoria.

Yield: Trees come relatively early into cropping mode. Very low annual crop. By mid-June, many of the fruitlets drop.

Fruit quality: for jam. Victoria like type of plum. Yellow-red, oblong Victoria-shape fruit. The red skin colour could have a flash of blue. Fruit size is small (43 g), even at low crops. The appearance of the fruit is not nice due to bruising and discoloration of the fruit. Quite thin but tough skin with a very bitter taste. Hardly skinnable. Fruit flesh is yellow. A considerable amount of bloom on the fruit makes a 'grey'- not nice impression. Quite mealy fruit flesh. A lot of gummosis within the flesh observed some years, some years less. Medium to high fruit firmness and acidity, medium soluble solids content. Mostly freestone fruit. Fruit skin can get some cracking in the suture by heavy rain.

Taste: Some years quite sweet but the taste receives very low score. The bitter component in the skin dominates too much. The bittersweet fruits might be used for jam.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading tree habit. Medium to strong vigour.

Drawbacks: Low yields. Weak taste. Moderate nice appearance mainly due to the white bloom covering the skin and discoloration after bruising.

Conclusion: R 24 have not shown any beneficial traits compared to standard Victoria. Low crops, small fruit size, poor taste quality and discoloured and not nice appearing of fruits. R 24 is not recommended for commercial growing.

R 25



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollinated

Ripening time: late, one week after standard Victoria.

Flowering: varying from low to abundant. Early flowering time - 1 day before Victoria.

Yield: Trees come slow into cropping mode. Moderate to low crop. Some signs of biannual bearing. Need to be harvested before the fruit skin turn very red, otherwise, the fruit can get soft. Several picks needed.

Fruit quality: for fresh consumption and jam. Oblong Victoria-shape, red mottled or red spotted fruit. Amount of red coloration can vary a lot. Nice looking fruit. Fruit size can vary a lot from big to quite small, on average 57 g. Medium coarse fruit flesh. Quite thick and tough skin with some bitter taste, skinnable. Luminous, yellow fruit flesh. Medium to considerable amount of bloom on the fruit. Overripe fruits can get soft and flesh translucent in cold store. No gummosis within the flesh. High fruit firmness and medium acidity, high soluble solid content. Mostly clingstone or just partly freestone fruit. Skin can crack by heavy rain.

Taste: Skin taste tart and a bit bitter. Low juiciness in the flesh. Taste quality vary from one year to another from sweet and good to too tart /bitter and low. Fruits taste can lack character and receive medium taste score.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading tree habit. Moderate to strong vigour.

Drawbacks: Uneven quality. Moderate- low yields. Mostly clingstone fruit.

Conclusion: R 25 is a late ripening Victoria type of plum. It has not shown any big advantage traits compared to standard Victoria. Uneven fruit quality and yield. R 25 is not recommended for commercial growing.

3.2 Trial 2016. Evaluation of 11 plum cultivars originated from Norway and Serbia

3.2.1 Phenology of flowering

The beginning of plum flowering depended on the cultivar and varied on the average of three years from April 25 till May 7 (Table 6). Though difference between early flowering Raud Victoria mutant and late flowering Timočkanka was even 12 days, significant differences of the beginning of flowering between tested cultivars were not established. The reason could be a great year to year variation.

Table 6. Flowering phenology, date, average 2019-2021.

Cultivar	Beginning of flowering	Full flowering	End of flowering	Flowering abundance, 1-9
Boranka	May-02	May-05 ± 4.9 abc	May 14 ab	6.0 ± 1.8 bc
Čačanska najbolja	May-01	May-03 ± 5.1 abc	May 12 ab	7.8 ± 0.3 a
Čačanska rana	May-02	May-05 ± 6.1 abc	May 13 ab	5.0 ± 3.1 c
Ellen	May-04	May-07 ± 5.7 ab	May 15 ab	5.3 ± 2.4 c
Čačanska leptotica	May-01	May-04 ± 5.4 abc	May-12 ab	7.6 ± 1.5 a
Opal	May-01	May-04 ± 5.4 abc	May-12 ab	6.9 ± 2.5 ab
Ruudiplomme	Apr-26	Apr-29 ± 6.1 bc	May-08 b	6.2 ± 0.8 bc
Søgneplomme	May-01	May-04 ± 5.9 abc	May 12 ab	5.9 ± 2.6 bc
Timočkanka	May-07	May-10 ± 7.2 a	May 18 a	6.1 ± 2.3 bc
Raud Victoria mutant	Apr-25	Apr-29 ± 5.9 c	May 07 b	8.4 ± 1.1 a
Gul Yakima mutant	Apr-29	May-02 ± 6.0 abc	May 11 ab	7.1 ± 0.8 ab

Values within a column that do not share the same letter are significantly different

Significant differences were found between cultivars in full flowering time (Table 6, Fig. 11). Cultivar Timočkanka had the latest full flowering date in all years of observations, when cultivars Raud Victoria mutant and Ruudiplomme had the earliest. Difference in full flowering date between the earliest and the latest cultivar depended on year conditions and was 8 days in 2019, 11 days in 2021 and even 18 days in unfavourable 2020. Significant differences between mentioned cultivars were established evaluating the end of flowering too.

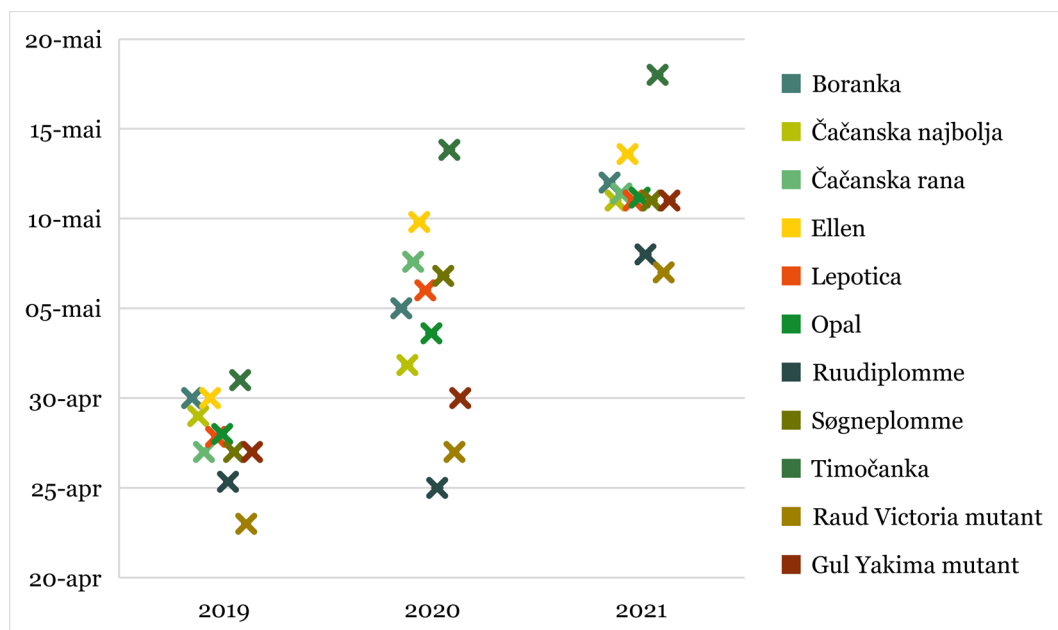


Fig. 10. Variation of full flowering dates.

Cultivars Raud Victoria mutant, Čačanska najbolja and Čačanska lepotica had the most abundant flowering during all years of observations (Table 6). Only cultivars Opal and Gul Yakima mutant did not differ significantly. On the opposite, cultivars Čačanska rana and Ellen were evaluated as having only moderate flowering abundance. Flowering abundance of other tested cultivars was rated from moderate to good.

3.2.2 Tree vigour

Due to uneven initial quality of planting material, plum tree vigour in this trial was evaluated visually. Cultivars Čačanska rana, Ruudiplomme, Raud Victoria mutant and Gul Yakima mutant were the most vigorous (Table 7). Vigour of cultivars Ellen and Timočanka trees was evaluated as weak.

Yield and productivity

Evaluation of fruit set revealed significant differences between cultivars (Table 7). Cultivar Søgneplomme had the highest fruit set and only fruit set of Čačanska Lepotica did not differ significantly. Very low fruit set was recorded for cultivars Čačanska rana and Ruudiplomme. Cultivars Timočanka and Ellen had a low fruit set.

Ability of cultivar to set fruits in big extend was correlated with the productivity of cultivar. Productivity or yield efficiency was calculated based on the 2021 yield, which was the highest yield during the experiment period, and tree trunk cross sectional area in the same year. Combining tree growth vigour and yield, cultivars Søgneplomme and Opal were the most productive and produced 0.65 and 0.59 kg of fruits per 1 cm² per trunk area. Tree yield efficiency was not related to tree vigour. Strong growing Čačanska rana and Gul Yakima mutant and weak growing Ellen had the lowest yield efficiency and produced two time less (around or less than 300 g) fruits than Søgneplomme and Opal.

Table 7. Tree vigour, bearing and productivity of plum cultivars.

Cultivar	Tree vigour	Fruit set, 1-9 Average, 2019, 2021	Productivity, kg/cm ² TCSA, 2021	Fruit harvest date, 2019-2021
Boranka	moderate	4.9 ± 0.74 cd	0.38 ± 0.05 defg	Sep-13 ± 4.0 a
Čačanska najbolja	moderate	5.7 ± 0.41 bc	0.36 ± 0.08 defg	Sep-10 ± 7.4 a
Čačanska rana	strong	2.7 ± 0.54 f	0.27 ± 0.04 g	Aug-13 ± 2.0 d
Ellen	weak	4.0 ± 1.07 de	0.28 ± 0.06 g	Aug-20 ± 4.4 cd
Čačanska lepotica		6.5 ± 0.71 ab	0.45 ± 0.10 cde	Aug-25 ± 6.5 bcd
Opal		6.0 ± 0.84 b	0.59 ± 0.08 ab	Aug-14 ± 2.3 cd
Ruudiplomme	strong	2.9 ± 0.14 ef	0.40 ± 0.12 cdef	Aug-20 ± 1.6 cd
Søgneplomme	moderate	7.3 ± 1.41 a	0.65 ± 0.17 a	Aug-29 ± 4.5 bc
Timočanka	weak moderate	3.8 ± 0.59 e	0.35 ± 0.04 efg	Sep-03 ± 3.2 ab
Raud Victoria mutant	strong	5.1 ± 0.59 c	0.51 ± 0.08 bc	Aug-22 ± 1.2 cd
Gul Yakima mutant	strong	6.3 ± 0.40 b	0.31 ± 0.04 fg	Aug-28 ± 2.8 bc

Values within a column that do not share the same letter are significantly different

3.2.3 Harvest time

During the last three years of the experiment, all cultivars were fruiting. The average harvest time of cultivars Čačanska rana and Opal was the earliest - August 13-14. The latest harvest in September 10-13 was recorded for cultivars Boranka and Čačanska najbolja, followed by Timočanka in September 03.

During three years of observations the biggest variation of harvest time was recorded for Čačanska najbolja – 15 days, and Čačanska lepotica – 13 days (Fig. 11). Cultivars Raud Victoria mutant, Ruudiplomme and Čačanska rana distinguished by very stabile harvest time – only 2-4 days variation during three years.

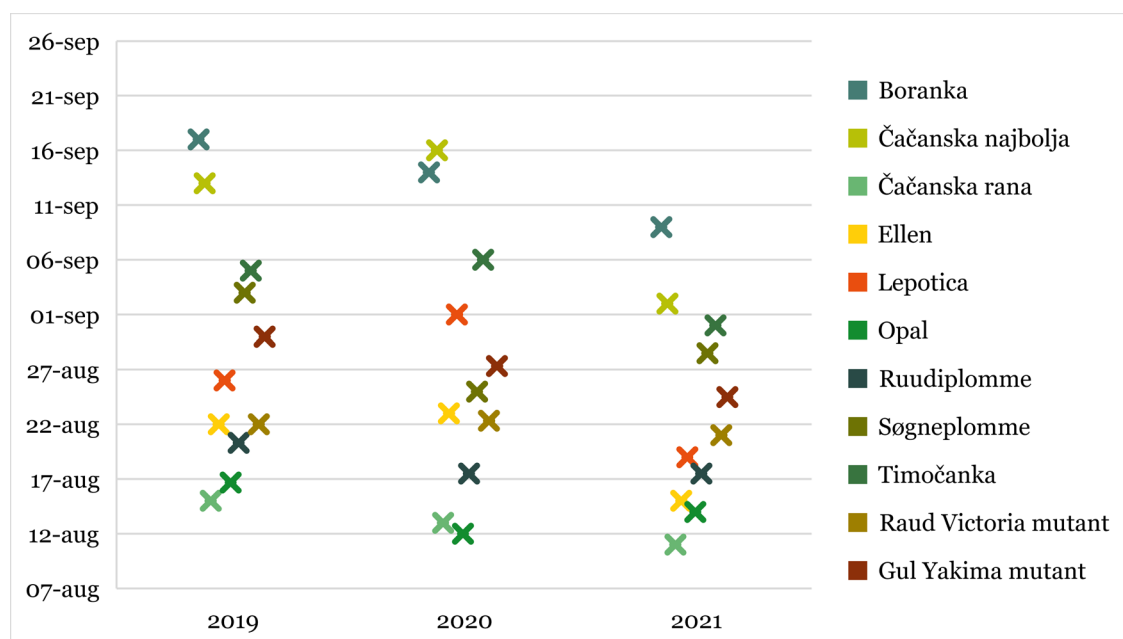


Fig. 12. Variation of harvest dates of tested plum cultivars.

3.2.4 Fruit quality.

Fruit weight and diameter. The average fruit weight of Timočanka reached more than 60 g and was significantly higher than the rest of tested cultivars with the exception of Rudiplomme which average fruit weight reached 54 g (Table 8). Fruits of these two cultivars and Søgneplomme had also the largest fruit diameter. The lowest fruit weight (31 g) and significantly smallest fruit diameter was recorded for cultivars Opal and Gul Yakima mutant. Another two cultivars Boranka and Ellen distinguished by low fruit weight too.

High variation of average fruit weight (14-16 g) during the 3 years of observations was recorded for Boranka, Opal and Raud Victoria mutant.

Table 8. Fruit quality characters, average 2019-2021.

Cultivar	Weight, g	Diameter (mm)	Bloom (1-9)	Gummosis
Boranka	34 ± 6.8 ef	34.0 d	5.8 ± 1.6 bcd	no
Čačanska najbolja	51 ± 5.6 bc	41.8 bc	8.7 ± 0.3 a	little
Čačanska rana	50 ± 5.5 bc	40.3 c	7.3 ± 0.4 abc	no
Ellen	38 ± 2.4 def	40.3 c	5.8 ± 2.3 bcd	no
Čačanska lepotica	43 ± 4.7 cde	40.1 c	8.0 ± 0.8 abc	no
Opal	31 ± 7.8 f	39.0 c		
Ruudiplomme	54 ± 5.1 ab	45.1 ab	8.4 ± 0.8 ab	little
Søgneplomme	45 ± 5.1 cd	44.7 ab	4.7 ± 1.4 cd	no
Timočanka	62 ± 2.2 a	47.2 a	6.0 ± 1.0 bcd	little
Raud Victoria mutant	44 ± 8.2 cd	44.0 b	4.8 ± 1.8 cd	little
Gul Yakima mutant	31 ± 6.5 f	35.3 d	3.8 ± 1.6 d	no

Values within a column that do not share the same letter are significantly different

Fruit colour. 100% blush covered fruits of cultivars Timočanka, Ruudiplomme, Lepotica, Čačanska rana and Čačanska najbolja (Table 9). Most of other cultivars had extensively coloured fruits too. Gul Yakima mutant was the only cultivar without blush with completely yellow fruits. Fruits of cultivar Boranka had grey-red colour. Cultivars Søgneplomme, Raud Victoria mutant and Ellen were red fruited. Fruit colour of the rest of cultivars was blue or different combinations of blue.

Fruit flesh colour was mostly yellow or yellow orange, only Lepotica, Čačanska najbolja and Boranka had more greenish flesh.

Table 9. Fruit colour characters, average 2019-2021.

Cultivar	Area of over colour (1-9)	Over colour	Colour of flesh
Boranka	6.5 d	grey green, grey red	green yellow
Čačanska najbolja	9.0 a	dark blue	green, green white
Čačanska rana	9.0 a	red blue	yellow orange
Ellen	8.1 bc	red	yellow, yellow orange
Čačanska lepotica	9.0 a	blue	green yellow
Opal	7.7 c	light red	yellow
Ruudiplomme	9.0 a	red blue	yellow, yellow orange
Søgneplomme	7.6 c	red	yellow
Timočanka	9.0 a	dark blue	yellow
Raud Victoria mutant	8.6 ab	red	yellow, yellow orange
Gul Yakima mutant	1.0 e	yellow	yellow

Values within a column that do not share the same letter are significantly different

Fruit firmness depends on fruit maturity stage, but cultivar factor is significant too. Cultivars Timočanka, Søgneplomme, Opal and Čačanska najbolja at harvest had firm fruit flesh (Firmtech value more than 370) (Table 10). The low flesh firmness was recorded for Čačanska rana and Gul Yakima mutant.

Fruits of most of tested cultivars contained only medium or low soluble solid content (13.7 – 15%). Only two cultivars Boranka and Ellen distinguished by very high SSC – 21.6% and 19.2% respectively.

Test panel evaluation indicated cultivars with the best tasting fruits (Table 10). Cultivar Ellen received the highest average evaluation, but the fruit taste of the most of other cultivars was rated moderately high and did not differ significantly. Only two cultivars Čačanska najbolja and Søgneplomme had fruits with very moderate taste. Fruit taste depended on the crop load and year conditions and high variation of taste score was recorded for some cultivars as Čačanska rana and Søgneplomme, which taste was rated from not satisfactory in one year till good in another.

Table 10. Fruit chemical content and taste, average 2019-2021.

Cultivar	Fruit firmness	SSC %*	Acidity %	Fruit taste (1-9)
Boranka	330 ± 15.8 bc	21.6 ± 2.5 a		7.0 ± 1.0 ab
Čačanska najbolja	373 ± 16.5 a	15.8 ± 1.7 c		5.0 ± 0.5 b
Čačanska rana	266 ± 48.2 de	14.8 ± 1.5 c		6.8 ± 1.8 ab
Ellen	337 ± 13.6 abc	19.2 ± 2.0 ab		8.0 ± 1.0 a
Čačanska lepotica	270 ± 15.9 e	14.9 ± 1.7 c		7.3 ± 0.4 ab
Opal	371 ± 24.6 a	16.5 ± 1.9 bc		7.0 ± 0.2 ab
Ruudiplomme	318 ± 16.4 cd	14.9 ± 0.8 c		7.0 ± 0.2 ab
Søgneplomme	370 ± 14.6 a	13.7 ± 0.1 c		4.7 ± 2.3 b
Timočanka	372 ± 19.3 a	15.3 ± 2.8 c		7.0 ± 1.3 ab
Raud Victoria mutant	313 ± 19.1 cd	15.9 ± 0.9 c		6.6 ± 2.1 ab
Gul Yakima mutant	244 ± 18.0 e	15.3 ± 1.3 c		6.0 ± 1.5 ab

Values within a column that do not share the same letter are significantly different

3.2.5 Cultivar descriptions

Raud Victoria mutant



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria mutation

Ripening time: Ripens along with standard Victoria.

Flowering: abundant. Early flowering 4 days before Opal.

Yield: Trees come early into cropping mode. Low yields, with the exception of one year. Fruit can easily drop, at least two picks are needed.

Fruit quality: For fresh consumption and jam. Fully red coloured, quite Victoria like type of plum with red lenticels. The fruit shape is oblong. When full cropping, fruit size is low (44 g) and quite big fruit size when yield is low. The skin colour is even, nice red with lot more red cover colour than standard Victoria. Yellow-orange, juicy fruit flesh. Translucent parts in the fruit flesh can occur. The skin is medium thick, tough, with a weak sour taste. It is hard to peel the skin off. Moderate to medium amount of bloom on the fruit. Some gummosis within the flesh observed. In addition, some Monilia rot can occur. Medium fruit firmness. Totally freestone fruit. Skin can easily get cracks by heavy rain.

Taste: Taste quality vary from year to year from good to medium. Medium acid and soluble solid content. Skin taste distinct bitter and sour. In total, some years very good taste and some years without character.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading- dropping. Strong vigour.

Drawbacks: Uneven fruit quality. Low/uneven crops. Tendency to crack in rain.

Conclusion: Most years, too low yields, too small fruits and uneven consumption quality. Raud Victoria mutant shows no obvious beneficial traits compared to standard Victoria. Raud Victoria mutant is not recommended for commercial growing.

Rudiplomme



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollination.

Ripening time: Ripens 1-2 days after Opal

Flowering: abundant. Early flowering 3 days before Opal.

Yield: Trees come early into cropping mode. Low yields, with the exception of one year. Important to harvest at the red fruit stage, otherwise fruits will gain blue colour and be overripe. Annual bearing habit.

Fruit quality: For fresh consumption. Big fruit size 55 g. Fruit shape oblong. Skin colour red-blue. Skin covered with quite amount of bloom. Almost no gummosis within the fruit flesh. Fruits can get some rain induced cracking. Very firm fruit flesh. Partly freestone. The skin taste quite bitter. The skin is thin, but tough. Quite coarse texture in the flesh and in overripe fruits. Red fibre treads in the flesh can occur.

Taste: Good taste. When the fruit has normal ripeness development, the bitter taste becomes more obvious. Medium soluble content, but even so, the fruits achieve high taste score. Medium juicy.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: upright, strong growing trees.

Drawbacks: Low/uneven crops.

Conclusion: Interesting fruit quality. A DNA-test should be performed to reveal if Rudiplomme is the same as the cultivar Anne (R 21).

Søgneplomme



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Victoria open pollination.

Ripening time: Ripens along with standard Victoria.

Flowering: varying from moderate to abundant. Flowering time as Opal.

Yield: Trees come very early into cropping mode. Varying from low to high. At least two picks are needed. Biannual bearing habit.

Fruit quality: For fresh consumption and jam. Oblong Victoria-shape, nice yellow ground colour and red coloured – red spotted fruit cover colour, a bit blunt at the end. Fruit size (45 g) is medium, but dependent on early and sufficient thinning. Quite coarse, ravelled fruit flesh. Quite thick and tough skin with some bitterness taste, skinable. Skin can be discoloured after bruising. Yellow fruit flesh. The flesh can get translucent parts. Medium amount of bloom on the fruit. Overripe fruits can get flesh that soften and develop translucent parts on the tree and in cold store. Translucent flesh parts get brownish. Firm fruit flesh. Totally clingstone fruit. Cracked stones can occur.

Taste: The taste can vary from one year to another. Quite good, some years to weak depending on weather condition, crop load and ripening stage. Overripe fruit do not have acceptable taste. Medium juicy flesh. Moderate acid and low soluble solid content. In addition to a taste with no character, the bitter-sour skin makes taste weak.

Disease resistance: The fruits can get some Monilia rot attack. Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading tree habit – nice angled branches. Moderate vigour.

Drawbacks: Totally clingstone fruit. Varying consumption quality, translucent – brownish fruit flesh. Likely to be biannual bearer.

Conclusion: In spite of nice, yellow and red coloured fruits, fruit consumption and storing qualities are too weak and yield is uneven. Søgneplomme is not recommended for commercial growing.

Gul Yakima mutant



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: Einar Ruud, Søgne.

Parents: Yakima mutation.

Ripening time: Ripens along with standard Victoria or a bit before.

Flowering: abundant. Flowering time 1 day before Opal.

Yield: Trees come early into cropping mode. Low yields, with the exception of one year. Fruits are well attached to the branch. Must be harvested with stem. At least two picks are needed.

Fruit quality: for jam. Totally yellow coloured, oblong, small size fruit (32 g). Fruit turn very discoloured by bruising. Appearance is therefore not nice. Thin skin, which is partly skinable. Just a little bloom on the fruit. Yellow, fine-grained fruit flesh. No gummosis within the flesh. Soft fruits. Just partly freestone fruit by increasing maturity. Skin can get some cracking by heavy rain.

Taste: Medium acid and soluble solid content. Skin taste medium sour and a clear bitter. Taste varying by years, some good, and some weak. In weak years, the fruit lack character and bitterness is too dominant. Low juiciness in flesh.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: upright, strong growing trees.

Drawbacks: Discoloration in the skin. Too small fruit size. Varying consumption quality.

Conclusion: Gul Yakima mutant is not recommended for commercial growing.

Timočanka



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: Institute of Horticulture, Čačak, Serbia. Released 2004. Breeder: D.Ogašanović, V.Papić, R.Plazinić and M.Ranković

Parents: Stanley x California Blue

Ripening time: Late, ripens 3 - 4 days after Victoria.

Flowering: moderate to abundant. Late flowering 4 days after Opal.

Yield: Trees come slow into cropping mode. Low yields, with the exception of one year. Right maturity stage is a bit difficult to establish from fruit colour. Many fruits develop mature parts by the style end, while the rest of the fruit remain unripe. Fruits can easily drop.

Fruit quality: for fresh consumption and jam. Very big (62 g), round to oblong prune type of fruit. Surface colour is dark blue with clearly visible brown lenticels. Very coarse, red ravelled fruit flesh. Quite thick and tough skin with sour taste, which is skinable. Yellow fruit flesh. The fruit has a lot of bloom. Stored fruits got soft and flesh translucent in cold store (+ 2.5 °C). Gummosis within the flesh can occur. By development of gummosis, the stone can crack. Very firm fruits. Totally clingstone fruit.

Taste: The taste can vary from one year to another. High acid, moderate to low soluble solid content. Some years well ripe fruit have good, sweet taste, other years the taste lack character. The skin taste a bit sour and bitter. Translucent /brownish fruit flesh has weak taste. Unripe fruits taste to acid. Medium juicy flesh.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Spreading tree habit. Weak to moderate vigour.

Drawbacks: Late bearing start and low yields. Fruits get translucent in cold store. Easy dropping. Weak consumption quality. Totally clingstone fruit.

Conclusion: Timočanka is not recommended for commercial growing.

Čačanska najbolja



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: Institute of Horticulture, Čačak, Serbia. Released 1975. Breeder: S.Paunović, M.Gavrilović and P.Mišić.

Parents: Wangenheims Frühzwetsche x Požegača

Ripening time: Late, ripens 3-4 days after Victoria.

Flowering: abundant. Early flowering 1 day before Opal.

Yield: Trees come slow into cropping mode. Low yields, with the exception of one year. Fruits can easily drop.

Fruit quality: for fresh consumption and jam. Big (51 g), round to oblong prune type of fruit. Surface colour is dark blue. Surface colour is dark blue. Fine grained, green-white fruit flesh with red treads within the fruit flesh. Thick and tough skin, which is skinable. The fruit has a lot of bloom. Gummosis within the flesh can occur. High fruit firmness. Totally clingstone fruit.

Taste: Well ripe fruit can reach acceptable taste, but overall is the taste all testing years ranged to medium, mainly because the distinct bitter and sour taste of the skin. Moderate soluble solid content. Firm and medium juicy flesh.

Disease resistance: Trees have been healthy. No tree loss during the test period. Tolerant to Plum pox virus.

Tree habit /shape /vigour: Upright tree habit. Moderate vigour.

Drawbacks: Low yields. Not satisfactory taste quality. Totally clingstone fruit.

Conclusion: Čačanska najbolja is not recommended for commercial growing.

Boranka



Photo: Oddmund Frøynes, NIBIO

Origin/breeder: Institute of Horticulture, Čačak, Serbia. Released 2004. Breeder: D.Ogašanović, R.Plazinić, S.Stamenković and V.Milinković.

Parents: California Blue x Ruth Gerstetter

Ripening time: Very late, ripens 1 month after Opal. (According to breeders ripens very early).

Flowering: moderate to abundant. Flowering 1 day after Opal.

Yield: Trees come slow into cropping mode. Low yields, with the exception of one year. Right maturity stage is a bit difficult to establish from fruit colour. Many fruits develop mature parts, while the rest of the fruit remain unripe.

Fruit quality: for jam. Small (34 g), oblong prune type of fruit. Surface colour is green with a scarce red- or purple-blue blush. With lot a lot of bloom on the skin, it gives a not nice, grey-wan impression. Quite thin but tough skin, which is skinable. Skin can crack in rain. Medium to high fruit firmness. Partly freestone fruit.

Taste: Very high soluble solid content. The taste is very sweet-bitter and good, but lacks some more sour elements. Medium juicy flesh.

Disease resistance: Most trees have been healthy, lost one tree the test period. Tolerant to Plum pox virus.

Tree habit /shape /vigour: Upright tree habit. Moderate vigour.

Drawbacks: Weak fruit appearance, small fruits, low yields.

Conclusion: Due to very sweet and good fruit taste, might be used for jam. Boranka is not recommended for commercial growing.

Čačanska rana



Photo: Nebojsa Milosevic, Cacak

Origin/breeder: Institute of Horticulture, Čačak, Serbia. Released 1975. Breeder: S.Paunović, M.Gavrilović and P.Mišić.

Parents: Wangenheims Frühzwetsche x Požegača

Ripening time: Early, 1 day before Opal.

Flowering: low to moderate. Mid - early flowering 1 day after Opal. Self-sterile trees.

Yield: Trees come very slow into cropping mode. Low yields, with the exception of one year. Fruits can easily drop. The fruit should be red, not blue by harvest. Blue fruits are overripe.

Fruit quality: for fresh consumption. Big (50 g), oblong prune type of fruit. Surface colour is red-blue. Somewhat coarse grained, yellow fruit flesh with red treads within the fruit flesh. Thin and tough skin, which is skinable. The fruit has a lot of bloom. Moderate firm fruit. Freestone fruit. Can crack some in rain.

Taste: The fruit is juicy. Well ripe fruit can reach acceptable taste, but overall the taste is ranged to medium, mainly because the distinct bitter taste of the skin. Moderate acid and soluble solid content.

Disease resistance: Trees have been healthy. No tree loss during the test period. Tolerant to Plum pox virus.

Tree habit /shape /vigour: Very upright tree habit. Strong vigour.

Drawbacks Fruits drop easily. Low yields. Medium taste quality. Fruits can get Monilia rot.

Conclusion: Čačanska rana is an early ripening prune type with nice appearance. However, trees came late into cropping mode and yields have been low most years. The taste quality is not fully satisfactory. Čačanska rana is not recommended for commercial growing.

Ellen



Photo: Oddmund Frøyenes, NIBIO

Origin/breeder: A cross from NMBU by Johannes Øydvin.

Parents: Opal x Prune Pêche

Ripening time: Early, 2-3 days after Opal.

Flowering: low to moderate. Late flowering 3 days after Opal.

Yield: Trees come very slow into cropping mode. Low yields, with the exception of one year. Fruits can easily drop. The branches are densely covered with fruiting spurs, and thus the fruit is partly hidden behind leaves. Ripening development can be hard to establish from colour of the fruit. At least two picks are needed.

Fruit quality: for fresh consumption and jam. Nice, round oblong shaped fruit, red covered or - red spotted small fruit (37 g). Medium to a lot of bloom on the fruit. Yellow – light green fruit flesh. Skin can crack in heavy rain in the suture. Double fruits can occur. The skin is medium thick and tough. No gummosis within the flesh. High fruit firmness. Partly freestone fruit dependent on fruit maturity stage.

Taste: Very good, sweet, Rene Claude Oullins like taste. Moderate acid and high soluble solid content. The bit bitter and sour taste in the skin make the taste balanced.

Disease resistance: Trees have been healthy. No tree loss during the test period.

Tree habit /shape /vigour: Upright tree habit. Low vigour. The branches are densely covered with fruiting spurs.

Drawbacks: Small fruits. Low yields. Not satisfactory fruit appearance.

Conclusion: Due to very sweet and good fruit taste, might be used for jam. Ellen is not recommended for commercial growing.

4 Conclusions

Comprehensive phenological, pomological, agronomical, and biochemical studies of nineteen plum cultivars and selections were performed in 2013 – 2021.

Based on overall fruit quality, and tree productivity, cultivars selections NPr. 458 and Anne (R21) are selected for fresh consumption and can be recommended for further commercial growing tests. (It remains to see if a DNA-test reveals that Rudiplomme it is the same as cultivar Anne (R 21)).

Based on individual investigations of various fruit quality characters, especially on high sugar content, due to very sweet and good fruit taste, cultivars Boranka and Ellen might be used for processing purposes.

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