

Morphological characteristics and frost tolerance of cultivars derived from the *Rosa rugosa* Thunb.

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Abstract

Frost can damage rose plant and affects its performance in field under subfreezing conditions. Under severe cold conditions of North of Ukraine, use of winter-hardy rose cultivars is a suitable alternative for successful rose cultivation. Evaluation of 21 cultivars derived from *Rosa rugosa* Thunb. showed morphological characteristics and considerable frost tolerance and required no winter protection for their cultivation. Owing to their advantages, cultivars 'Abelzieds', 'Agnes', 'Conrad Ferdinand Meyer', 'Delicia', 'F.J. Grootendorst', 'Hansa', 'Henry Kelsey', 'Kaiserin des Nordes', 'Nova Zembla', 'Pink Grootendorst', 'Purple Roadrunner', 'Red Rugostar', 'Ritausma', 'Robusta', 'Rose a Parfum de l'Hay', 'Rotes Phanomen', 'Rugelda', 'Therese Bugnet', 'White Grootendorst', 'White Roadrunner', 'Yellow Dagmar Hastrup' are recommended for planting in urban green areas of zone 5 climate of Ukraine.

Key words: *Rosa rugosa* cultivars, morphological features, time of flowering, frost resistance

Introduction

Frost damage can affect rose plant performance in field under subfreezing conditions. Rugosa roses are the most winter hardy of all the roses grown in different parts of the globe. Most are hardy, beautiful, fragrant and bloom all summer with a wide range of colors from white to mauve (Bruun, 2005). Rose cultivars should preferably offer ornamental qualities during a large part of the year, thus leaves, flowers and hips are all important, as well as a natural plant shape that does not require pruning to look good and frost tolerance and Rugosa derived varieties show all such traits. The success of cultivation and ornamental value of shrubs is greatly affected by frost tolerance and cultivars derived from the *R. rugosa* are ones of few roses recommended for planting in the cool climate (Rieksta, 2003; McCaun, 2004; Mercure and Bruneau, 2008; Svejda, 2008; Monder, 2012; Yu *et al.*, 2014).

Kyiv is situated in the north of Ukraine – region, where extreme temperature is a limiting factor for rose growing. In Ukraine, cultivars of hybrid tea, floribunda and grandiflora classes can be grown without winter coverage in relatively small areas in the south regions. The important criteria for the suitability of rose cultivars in northern regions of Ukraine are good winter hardiness and high quality of flowers. The present research is focused on the evaluation of 21 cultivars derived from *Rosa rugosa* under Kyiv conditions.

Material and methods

Among 470 cultivars in the rose collection in M.M. Grishko Botanical Garden of National Academy of Sciences of Ukraine, there are 21 rose cultivars derived from the *Rosa rugosa* ('Abelzieds', 'Agnes', 'Conrad Ferdinand Meyer', 'Delicia', 'F.J. Grootendorst', 'Hansa', 'Henry Kelsey', 'Kaiserin des Nordes', 'Nova Zembla', 'Pink Grootendorst', 'Purple Roadrunner', 'Red Rugostar', 'Ritausma', 'Robusta', 'Rose a Parfum de l'Hay', 'Rotes Phanomen', 'Rugelda', 'Therese Bugnet', 'White

Grootendorst', 'White Roadrunner', 'Yellow Dagmar Hastrup') were evaluated under present investigation.

The location is characterized by an average yearly temperature of 7.7 °C, average rainfall of about 619 mm and altitude 190 m.a.s.l. In winter time records indicate average daytime temperatures reach -2 °C, falling to -7.7 °C during night. However, sometimes the temperature reaches -25 to -28°C, therefore most cultivars need winter protection.

The following data of rose cultivars were taken annually: height and width of shrubs, quantity of petals, diameter of flowers, colour of flowers, measured in the flowering period, damage caused by frost. The height and width of rose bushes were measured in the flowering period (the end of May, beginning of June).

Every year phenological data concerning time of flowering was recorded. The start of flowering was defined by the date when 10% of flowers were open and the end of the phenological characteristic was defined by the date when a majority of petals had fallen. Each year, damage caused by frost was recorded in spring according to the scale of Besschetnova (1975) (Table 1).

The shrubs were planted with proper spacing that provided the plants with appropriate growth condition. In the vegetation period of the shrubs, uniform package of practices were followed. The shrubs were not covered in winter.

Table 1. Level of roses' shoots damage by frost

Damage level	Symptoms of damage
0	Complete plant frost damage (no signs of regeneration)
1	Shoots frost-damaged up to the artificial protection (mound of soil or bark)
2	Shoots frost-damaged to up the ground surface (snow), but new shoots grow from the undamaged parts
3	Shoots frost-damaged half-length
4	Frost-damaged one-year-old shoot tips
5	Undamaged plants

Results and discussion

Differences in morphological features, flowering duration and frost tolerance were observed among rugosa cultivars. The morphological characteristics of rose cultivars showed variation in height and width of rose plants, quantity of petals, diameter and colour of flowers of rose cultivars (Table 2). Five cultivars ('Agnes', 'Conrad Ferdinand Meyer', 'Nova Zembla', 'Rose a Parfum de l'Hay', 'Therese Bugnet') have a considerable height of rose bushes. In case of most of the examined rugosas, flowering began much earlier, even by a month, in comparison

with numerous other cultivars from various other groups. The time of flowering of rose cultivars is summarized in Table 3.

The earliest-flowering varieties were 'Agnes', 'Conrad Ferdinand Meyer', 'Hansa', 'Nova Zembla', 'Robusta', 'Rose a Parfum de l'Hay', 'Therese Bugnet', whereas 'Delicia', 'Henry Kelsey' were last to flower. Most of cultivars had longer flowering period except 'Agnes' which flowered once.

The important criterion, which is one of the basic factors guaranteeing success of cultivation, is sufficient resistance to winter condition. In North Ukraine condition, rugosa cultivars

Table 2. Height and width of rose plants, quantity of petals, diameter and colour of flowers of rose cultivars

Rose cultivars	Height of shrubs (m)	Width of shrubs (m)	Number of petals	Diameter of flower (cm)	Colour of flowers
'Abelzieds'	1.3	1.0	10	6	Pink
'Agnes'	2.4	1.0	35	8	Yellow
'Conrad Ferdinand Meyer'	2.5	1.3	35	9	Pink
'Delicia'	1.5	0.8	14	11	Pink
'F.J. Grootendorst'	1.7	1.2	45	4	Raspberry
'Hansa'	1.6	1.5	20	9	Purple
'Henry Kelsey'	1.8	1.0	18	7	Red
'Kaiserin des Nordes'	1.7	0.7	15	9	Deep Pink
'Nova Zembla'	2.5	1.5	35	9	White
'Pink Grootendorst'	1.6	1.2	45	4	Pink
'Purple Roadrunner'	1.0	0.8	50	7	Purple
'Red Rugostar'	1.3	0.8	7	7	Red
'Ritausma'	1.5	1.0	30	8	Pink
'Robusta'	1.5	1.2	6	7	Red
'Rose a Parfum de l'Hay'	2.5	1.5	30	8	Purple
'Rotes Phanomen'	1.0	0.7	25	9	Mauve
'Rugelda'	2.0	0.9	45	7	Yellow, Red Edges
'Therese Bugnet'	2.0	1.0	25	8	Deep Pink
'White Grootendorst'	1.5	1.0	45	4	White
'White Roadrunner'	1.2	1.0			White
'Yellow Dagmar Hastrup'	1.0	1.4	20	8	Yellow

Table 3. Date of flowering of rose cultivars

Rose cultivars	Start of first flowering	End of first flowering	Start of second flowering	End of second flowering
'Abelzieds'	4.06	29.06	20.08	10.09
'Agnes'	18.05	2.06	-	-
'Conrad Ferdinand Meyer'	23.05	13.06	17.07	10.08
'Delicia'	4.06	5.07	25.07	5.09
'F.J. Grootendorst'	27.05	5.07	20.08	1.09
'Hansa'	23.05	15.06	20.07	1.08
'Henry Kelsey'	1.06	16.06	8.07	25.07
'Kaiserin des Nordes'	25.05	15.06	10.07	1.08
'Nova Zembla'	23.05	13.06	17.07	3.08
'Pink Grootendorst'	27.05	5.07	20.08	3.09
'Purple Roadrunner'	25.05	15.06	5.07	25.08
'Red Rugostar'	29.05	25.06	10.07	3.08
'Ritausma'	25.05	5.06	1.07	20.07
'Robusta'	22.05	20.06	29.06	1.08
'Rose a Parfum de l'Hay'	20.05	5.06	15.07	10.08
'Rotes Phanomen'	2.06	3.07	10.07	28.08
'Rugelda'	25.05	4.07	20.07	1.09
'Therese Bugnet'	20.05	7.06	1.08	14.08
'White Grootendorst'	27.05	6.07	21.08	2.09
'White Roadrunner'	25.05	14.06	10.07	27.07
'Yellow Dagmar Hastrup'	27.05	20.06	15.07	14.08

were characterized by high and stable frost tolerance in most of cases (Table 4). This makes their cultivation possible under frost conditions. Shoots of cultivar ‘Rugelda’ were half-length frost-damaged, but they quickly regenerated achieving their characteristic size.

Table 4. Frost damage (2010-2015) in rose cultivars in Kyiv according to the scale of Besschetnova (1975)

Rose cultivars	2010	2011	2012	2013	2014	2015
‘Abelzieds’	5	5	5	5	5	5
‘Agnes’	5	5	5	5	5	5
‘Conrad Ferdinand Meyer’	4	4	4	4	4	4
‘Delicia’	5	5	5	5	5	5
‘F.J. Grootendorst’	5	5	5	5	5	5
‘Hansa’	5	5	5	5	5	5
‘Henry Kelsey’	4	4	4	4	4	4
‘Kaiserin des Nordes’	5	5	5	5	5	5
‘Nova Zembla’	4	4	4	4	4	4
‘Pink Grootendorst’	5	5	5	5	5	5
‘Purple Roadrunner’	4	4	4	4	4	4
‘Ritausma’	5	5	5	5	5	5
‘Red Rugostar’	4	4	4	4	4	4
‘Robusta’	4	4	4	4	4	4
‘Rose a Parfum de l’Hay’	5	5	5	5	5	5
‘Rotes Phanomen’	4	4	4	4	4	4
‘Rugelda’	3	3	3	3	3	3
‘Therese Bugnet’	5	5	5	5	5	5
‘White Grootendorst’	5	5	5	5	5	5
‘White Roadrunner’	4	4	4	4	4	4
‘Yellow Dagmar Hastrup’	4	4	4	4	4	4

R. rugosa, which grows in northern Japan, China and Siberia, is among the hardiest species. It is known for simultaneously frost tolerance and recurrent bloom, features which are seldom found together in roses (Anderson, 2007; Mercure and Bruneau, 2008; Svejda, 2008; MacPhail and Kevan, 2009; Fu *et al.*, 2016).

Breeders became interested in *R. rugosa* and this resulted in developing numerous cultivars by crossing the Rugosa with cultivars of other rose groups. Owing to their advantages, cultivars, derived from the *R. rugosa*, were evaluated in Kyiv. Our results confirmed specific morphological characteristics and frost tolerance of 21 rugosa cultivars (‘Abelzieds’, ‘Agnes’, ‘Conrad Ferdinand Meyer’, ‘Delicia’, ‘F.J. Grootendorst’, ‘Hansa’, ‘Henry Kelsey’, ‘Kaiserin des Nordes’, ‘Nova Zembla’, ‘Pink Grootendorst’, ‘Purple Roadrunner’, ‘Red Rugostar’, ‘Ritausma’, ‘Robusta’, ‘Rose a Parfum de l’Hay’, ‘Rotes Phanomen’, ‘Rugelda’, ‘Therese Bugnet’, ‘White Grootendorst’, ‘White Roadrunner’, ‘Yellow Dagmar Hastrup’) (Rieksta, 2003, McCaun, 2004, Svejda, 2008, Monder, 2012, Yu *et al.*, 2014). These roses are also grown successfully by gardeners in zone 5 climate. The findings of this study can provide insights for other researchers of *R. rugosa* and its cultivars.

Rosa rugosa cultivars in M.M. Grishko National Botanical Garden are in small number, which is likely to limit future genetic improvement. The addition of accessions to the collection of

Rugosa rose and the evaluation of morphological characteristics and frost tolerance will help the conservation of genetic diversity and breeding of new *R. rugosa* cultivars.

The examined cultivars derived from the *R. rugosa* show high tolerance to winter conditions. In North Ukraine, there is no or little damage caused by frost in most *R. rugosa* cultivars which confirms the specific characteristic of the species. ‘Rugelda’ exhibited adaptation ability under frost conditions as shoots of cultivar were frost-damaged half-length, but they quickly regenerated achieving their characteristic size. Flowering of the examined cultivars derived from the *R. rugosa* begins early, from the third week of May to the beginning of June. Most of cultivars had repeated flowering.

All cultivars derived from the *R. rugosa* growing in Kyiv, Ukraine have considerable morphological and visual flower characteristics and frost tolerance and perform satisfactorily without winter protection. Due to these advantages, cultivars, derived from the *R. rugosa* are recommended for planting in urban green areas. Addition of a good number of accessions to the collection will help in breeding and selection programmes for frost tolerant rose cultivars.

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