

over the work surface, good penetration through the grape bush, high or rather good degree of drip precipitation using injector or centrifugal atomizers. In terms of this research it was determined that applying the large-drop injector sprayer reduces drift of chemical preparations, improves quality and efficiency of pesticidal treatments.

Key words: *grape; equipment; spraying; dispersibility; sprayers; biological efficiency.*

PLANT CULTIVATION

UDC 635.92:582.923.5:631.542(477.75)

REGENERATIVE PRUNING PECULIARITIES OF *NERIUM OLEANDER* CULTIVARS WITHIN SOUTH COAST OF THE CRIMEA

Yelena Nikolayevna Spotar

Nikita Botanical Gardens – National Scientific Centre
298648, Republic of the Crimea, the city of Yalta, urban vil. Nikita
E-mail: elen_persic@mail.ru

Introduction

Due to warm Mediterranean climate on South Coast of the Crimea there is a large collection of evergreen arboreal plants, which are successfully used in green building to create landscape compositions of sanatoria - resorts zones and embankments. A quite important role goes to summer ornamental plants, capable to make resort guests and inhabitants happy. Oleander with high ornamental characteristics takes a special place here as it presents prolong continuous flowering period in summer-autumn. Though damaged shoots in severe for SCC winters cause some difficulties for this culture to be used in green building. As a result of hard damages by frosts some plants are subjected to renewal pruning till the stub.

Objective of our research is to determine regeneration terms of above-ground parts of oleander after pruning till the stub and its capacity to blossom the same year.

Objects and methods of the research

Material for our research was oleander collection of Nikita Botanical Gardens (NBG) aged by 4-30 years. At the same time visual observation after oleander plants being pruned till stub took part. These plants grow within detached areas under conditions of sufficient illumination and irrigation that is territory of parks: Alupka, Paradise, park of sanatorium Miskhor, Krym, Frunzenskoye; and embankments of Yalta and urban village Gurzuf, as well as unirrigated illuminated areas of some street plantations.

Phenological and biometrical observations after shoots were carried out by methodics developed in department of Dendrology and Floriculture [1], and making visual observations as well. As model specimens following plants were sorted out: 24 plants of 4 years (21 cultivars), growing under similar conditions on area with regular irrigation, 10 plants (6 cultivars) of 15-30 years, growing on different exposition sites under different care conditions, 30 plants of 70 years growing in Alupka (Vorontsov) park being under similar conditions with area regularly irrigated.

Results and discussion

Representatives of the only cultivar of *Nerium* L. Genus are plants with a high drought-resistance due to their xeromorphy. Ornamental properties combined with prolong flowering period (up to 90 days or more) make this culture widespread on the coast. Gardeners pay much attention to this oleander due to its easy cultivation, evergreen leaves

and of course its abundant flowering that starts from the beginning of June (in good years – from the end of May) and continue till the middle of October. Terms and time of oleander flowering to a large degree depend upon genotype, meteorological conditions and locality. Double-flowering group gets to start blossoming period 7-10 days later than plants of single group. In shady places plants are depressed: shoots stretch, blossoming period comes 2-3 weeks later than usual and keeps on for a little. Open areas favor intensive growth and abundant flowering of these plants. Southern exposition sites near building walls are also favorable localities for oleander cultivation, as they accumulate warmth in summer-autumn causing continuous blossoming of plants. Though due to their origin – from the coast of the Mediterranean Sea till Central Asia and Morocco, oleander doesn't possess frost-resistance that's why it inhabits only within the most southern parts of the Crimea – from Laspi in west till eastern border of Alushta. In the most severe for the Crimea winters, on non-wind-blown and unprotected places perennial shoots get damage by frost at -12 C° and freezes to the root, juvenile soft-wood shoots are damaged even at $-5-6\text{ C}^{\circ}$. As a result of such weather conditions oleander shoots are subjected to renewal pruning till stub. It's a well-known fact that on the Black Sea Coast of Caucasus (BCC) complete regeneration of oleander crowns after pruning till stub occurs in 3-4 years [4, 5]. As authors consider it's caused by high humidity on BCC this very factor keeps off process of shoot lignifications. That's why inflorescences of oleander plants are formed on lignified shoots. On South Coast of the Crimea (SCC) after freezing oleander is capable to regenerate its shoots fast enough and even start flowering the same year [3]. But there is a lack of data about shoot regeneration in cultivar profile.

Since 2012 till 2014 we conducted observations after oleander plants growth and development (21 cultivars), which were subjected to renewal pruning till stub, growing in similar conditions in introduction-collection nursery of Nikita Botanical Gardens.

Winter 2012 was characterized by unfavorable weather conditions for majority of introduction cultivars. At night from 1-2 February air temperature dropped down till $-11,9\text{ C}^{\circ}$ and was keeping on up for 12 hours, while from 7-8 of February frosty weather ($-9,4\text{ C}^{\circ}$) was accompanied by storm wind of 21-24 m/sec and reduction of relative humidity till 24-27% [2]. Such a decrease of temperature in subtropical zone is considered as natural phenomena. Severe damages were registered on 4-years oleander plants what forced renewal pruning till stub [6].

It is known that oleander is characterized by high capacity to form shoots. Development of shoot system of study plants occurred due to latent buds, located in close to crown plant part. Observations after study plants made it possible to rate efficiency of crown renewal process after pruning till stub.

In May 2012 even shoot growing was fixed. On 31.05.2012 average height made 12-14 sm (fig.1), on 9.08.2012 their growth intensity presented good results – on average 76 sm (fig.2).



Fig.1 Status of 4-years oleander plants growing on area of introduction and collection nursery after spring pruning forced by frost damages in February 2012. 31.05.2012



Fig. 2 Status of 4-years oleander plants on area of introduction and collection nursery. 9.08.2012

During vegetative period in 2012 a number of renewal shoots ranged from 3 till 7 with an average height of 80 sm. In 2013 this number increased till 5-11 with an average height of 120 sm. Next year average shoot height reached 150 sm while number of renewal shoots became 23 (table 1).

Table 1

Results of oleander crown recovery after forced renewal pruning till the stub, April 2012

Cultivar	2012				2013				2014			
	Pruning till the stub	Shoot height, sm	A number of shoots, units	Flowering	Partial pruning	Shoot height, sm	A number of shoots, units	Flowering	Partial pruning	Shoot height, sm	A number of shoots, units	Flowering
Prof. Granel	+	65	4	-	-	110	5	+	-	150	10	+
Max	+	90	4	-	-	155	6	+	-	160	14	+
Cousine Marie	+	130	7	-	-	200	9	+	-	220	13	+
Jean de Battalier	+	80	5	+	+	100	7	+	-	155	12	+
M-me Allen	+	85	6	-	+	115	7	+	-	200	9	+
Angèle Durac	+	60	6	-	+	90	7	+	-	120	12	+
Savort	+	90	6	-	-	135	6	+	-	210	8	+
Aurantiacum	+	95	3	+	+	120	6	+	-	145	6	+
Claude Blanc	+	115	4	+	+	145	9	+	-	145	11	+

M-me Planchon	+	115	7	+	-	160	8	+	-	170	11	+
Album Maximum	+	70	6	+	+	140	6	+	-	155	6	+
Splendens Giganteum	+	110	6	-	+	145	6	-	-	210	9	+
N.ol. var. atropurpureum hort.	+	45	4	-	+	95	6	+	-	130	6	+
Amabile	+	80	4	+	+	135	7	-	+	145	7	+
Loddigessii	+	70	6	-	+	100	7	+	-	110	9	+
Richardellaval	+	85	5	-	-	145	10	+	-	155	20	+
Prof. Martin	+	60	5	-	-	105	11	+	-	170	14	+
Eos	+	65	5	-	-	115	11	+	-	160	11	+
Gilbert Bravy	+	20	5	-	-	60	5	+	-	70	5	+
Splendens foliis variegatum	+	30	5	-	+	60	10	-	-	70	13	-
Inodorum Soulgelii	+	55	5	-	-	110	6	+	-	155	7	+

Urgent point of our observations is to determine regeneration degree of renewal shoots the same year after pruning. Minimal shoot height was fixed for cultivar with single crimson flowers Gilbert Bravy – 20 sm. A group of double cultivars with pink flowers were had maximum height (from 110-130 sm): Splendens Giganteum, Claude Blanc, M-me Planchon.

Formation of generative sphere of study cases (table 2) had the following picture: double cultivar with pink flowers Jean de Battalier (5.07) and single cultivar Aurantiacum (9.07) with fair salmon flowers were characterized by the earliest inflorescence development with budding start (hereinafter b.s.) 18.07 and flowering beginning (hereinafter b.fl.) 2.08.

Table 2

Generative sphere formation of oleander plants in 2012

Cultivar	Plant height, the end of	Formation of reproductive shoots	Budding start	Flowering start	The end of flowering	Flowering duration (a number of
----------	--------------------------	----------------------------------	---------------	-----------------	----------------------	---------------------------------

	2012, sm					days)	
Prof. Granel	65	29.08	-	-	-		
Max	90	31.08	-	-	-		
Cousine Marie	130	21.09	-	-	-		
Jean de Battalier	80	5.07	18.07	2.08	26.08	24	
Aurantia cum	95	I fl.	9.07	18.07	2.08	18.08	16
		II fl.	12.09	25.09	8.10	21.10	13
M-me Allen	85	18.09	-	-	-		
Angele Durac	60	20-30.08	-	-	-		
Savort	90	8.08	-	-	-		
Claude Blanc	115	1.08	16.08	28.08	19.09	22	
M-me Planchon	115	8.08	15.08	8.09	23.09	15	
Album Maximum	70	4.08	20.08	6.09	26.09	20	
Splendens Giganteum	110	30.08	-	-	-		
N.ol. var. atropurpureum hort.	45	23.08	-	-	-		
Amabile	80	20.08	5.09	22.09	20.10	28	
Loddigessii	70	9.08	-	-	-		
Richar de Dellaval	85	29.08	-	-	-		
Prof. Martin	60	15.09	-	-	-		
Eos	65	-	-	-	-		
Gilbert Bravy	20	-	-	-	-		
Splendens foliis variegatum	30	-	-	-	-		
Inodorum Soulgelii	55	-	-	-	-		

In the first decade of December cultivars Album Maximum (4.08) (a group of single white flowered cultivars), Savort (8.08), Claude Blanc (1.08), M-me Planchon (8.08) (double pink-flowered cultivars) and Loddigessii (9.08) (single red-flowered cultivar) started formation of inflorescences. Though budding with further flowering takes place only for Claude Blanc (b.s. 16.08; b.fl. 28.08), M-me Planchon (b.s. 15.08; b.fl. 8.09) and Album Maximum (b.s. 20.08; b.fl. 6.09).

Single pink-flowered cultivars Max, Angele Durac as well as double pink-flowered cultivars Prof. Granel, Splendens Giganteum, Amabile, Richar de Dellaval and red-flowered N.ol. var. atropurpureum hort. presented shoot formation in the third decade of August. In this case only Amabile (b.s. 5.09; b.fl. 22.09) initiated phase of budding and flowering.

Double white-flowered cultivar Cousine Marie, double pink-flowered cultivar M-me Allen and the single red-flowered cultivar Prof. Martin initiated development of reproductive shoots rather late (from 15.09 – 21.09). Budding and flowering phases weren't fixed for them. Though it's worth to point out Aurantiacum which presented the second flush of flowering 8.10.

In terms of the research it was found out only 5 oleander cultivars of both either double or single groups initiated flowering the same year after pruning. Concerning flowering period cultivars were classified as follows: the longest flowering period was fixed for Amabile (28 days); Jean de Battalier was in blossom 24 days; Claude Blanc and Album Maximum were flowering 22 and 20 days relatively; blossoming period of M-me Planchon made 15 days; Aurantiacum had the minimum period of flowering - 13 and 16 days. Shoot development is presented at figures 3-6.

In 2013 flowering period was fixed for 18 cultivars (table 1) in spite of forced renewal partial pruning carried out with 11 cultivars. Drop of air temperature till $-2,3^{\circ}\text{C}$ below zero accompanied by high wind of 30 m/sec on March the 24th determined the result we have. By the end of March air temperature rose till $+21,2^{\circ}\text{C}$ [3]. In 2014 all cultivars showed intensive flowering besides double pink-flowered cultivar *Splendens foliis variegatum* with golden and varicoloured leaves and weak development of shoots.

Besides study cases of IKP, there were 15-30 years plants of four oleander cultivars, growing in Arboretum of Nikita Botanical Gardens within different exposition sites (table 3); 3 of them - *Album Maximum*, *Splendidissimum*, *Italia* develop on open area, one cultivars - *Emile Sehut* grows in shady wind-blown place. *Album Maximum* and *Splendidissimum* initiated blossoming the same year after pruning having from 16-25 shoots with height of 60-90 sm. Cultivar *Emile Sehut* began to blossom next year after pruning. *Italia* was characterized by weak

growth and late beginning of flowering – in 2015.



Fig. 3 *Album Maximum*. Development of shoots, 2012



Fig. 4 Aurantiacum. Development of shoots. 2015

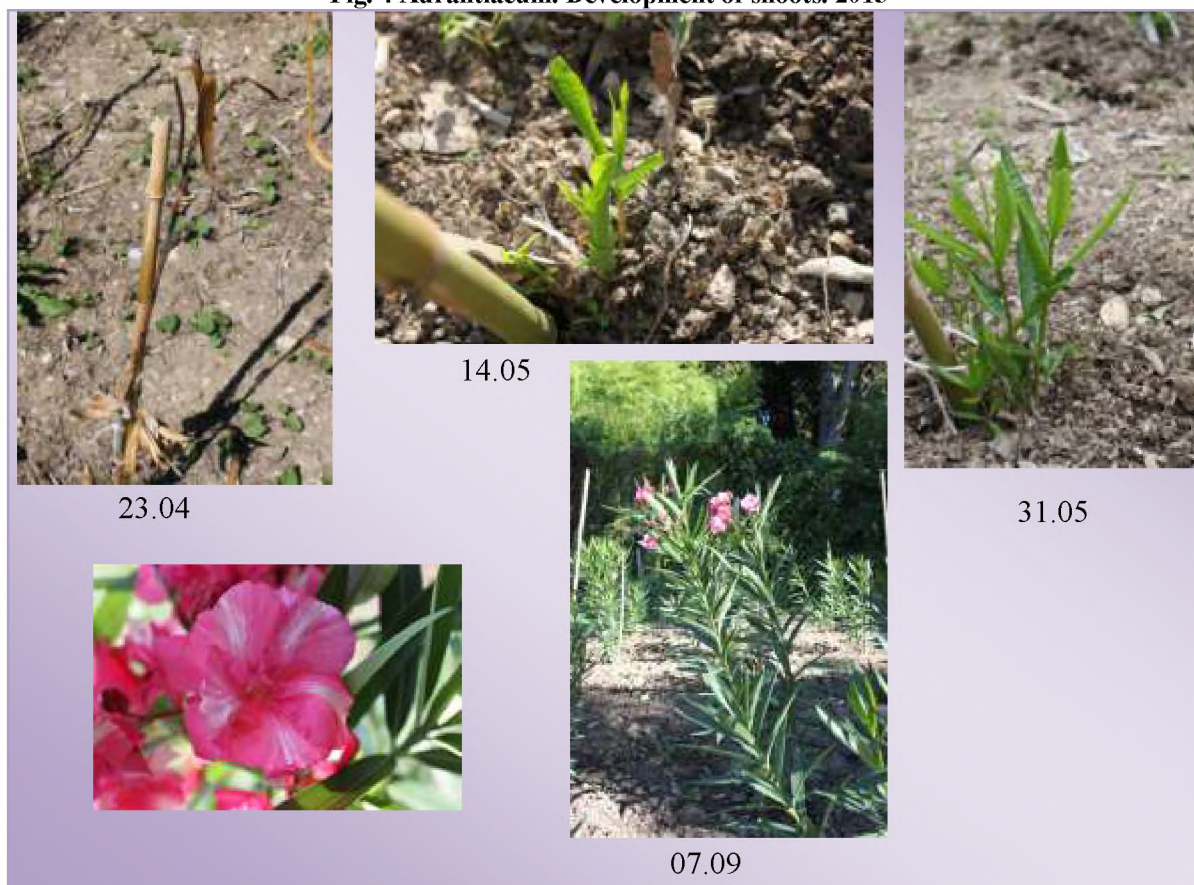


Fig. 5 Claude Blanc. Development of shoots. 2012

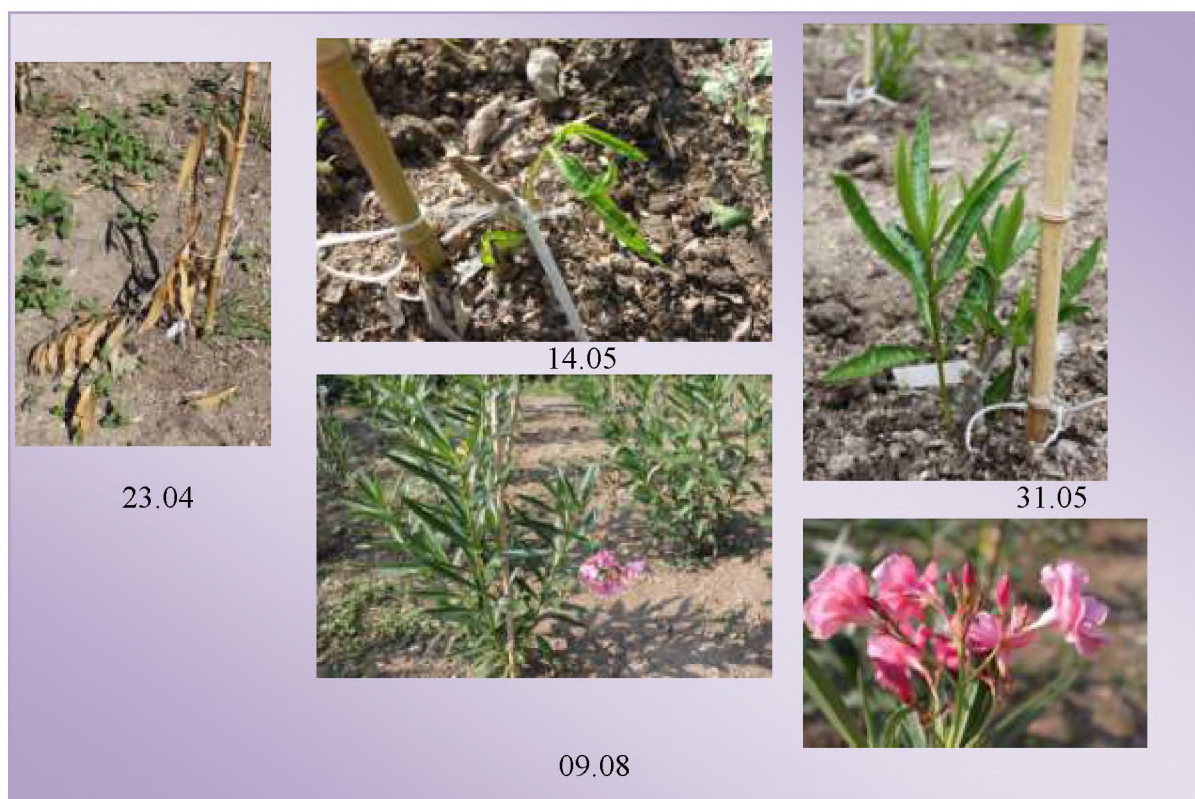


Fig. 6 Jean de Battalier. Development of shoots. 2012

Plants of double pink-flowered, growing in Alupka park of Vorontsov palace-museum (palm alley), were objects of our observations as well. In 2013 renewal pruning till stub of 70-years plants with diameter of stem branches till 15 sm resulted successful regeneration of all plants above-ground parts (30 specimens) during vegetative period of a current year; a number of renewal shoots reached 20 with height of 120 sm. Majority of these plants presented intensive blossoming in September.

Ten plants aged 15-20 years of Roseum cultivar, the most widespread on South Coast of the Crimea, were sorted out as control specimens. These plants grow in Arboretum under rather severe conditions being in need of regular irrigation. It was determined during the pruning year renewal shoots were 40-50 sm. Blossoming period happened a year later.

Table 3

15-30-years-old cultivars growing in Arboretum of Nikita Botanical Gardens

№	Cultivar	Plant status at year end 2012		Flowering		
		Height, sm	A number of renewal shoots, units	2012	2013	2014
1	Album Maximum	60	16	+	+	+
2	Splendidissimum	90	25	+	+	+
3	Emile Schut [*]	60	8	-	+	+
4	Italia	30	12	-	-	-

*- a plant grows on a shady wind-blown site of park

Conclusions

Observation with study plants made it possible to rate efficiency of crown regeneration as a result of rejuvenation pruning till stub.

It was found out that keeping all necessary measurements oleander plants subjected to forced rejuvenation pruning till stub are capable to renew lost crown easily during the pruning year.

Blossoming period comes during the pruning year depending upon cultivar and place of growth. If rejuvenation pruning till stub on South Coast of the Crimea is possible after strong frosting of stem branches, the same measurement isn't appropriate under conditions of high humidity on the Black Sea of Caucasus because of continuous (3-4 years) expectation for renewal crown and further blossoming. Due to this criterion oleander is welcome as a coppice culture in landscape gardening and green building on South Coast of the Crimea.

References

1. *Golubeva I.V., Galushko R.V., Kormilitsyn A.M.* Metodicheskiye ukazaniya po phenologicheskim nabludeniyam nad derevyami i kustarnikami pri ih introduktsii na yuge SSSR. – Yalta: NBS, 1977. – 25 s.
2. Danniye agrometeostantsii “Nikitsky sad” za 2012-2013 gg.
3. *Kuznetsova V.M., Karpun Yu.N.* Annotirovanny katalog “Oleandry v SSSR”. – Yalta: GNBS, 1993. – 93 s.
4. *Leiba V.V., Karpun Yu.N.* Oleandr v Abkhazii. Izd. 2-e, ilustrirovannoye. – Sochi, 2013. – 36 s.
5. *Leiba V.V., Karpun Yu.N.* Osobennosti omolazhyvayushchey obrezki oleandrov na Chernomorskom poberezhye Kavkaza. // Dekorativnoye sadovodstvo Rossii. – 2009. – Vyp. 42. T. I. – S. 81-83.
6. *Spotar Ye.N., Zakharenko G.S.* Osobennosti regeneratsii nadzemnoy chasti u *Nerium oleander* L. posle obmerzany v suroviye zimy na Yuzhnom beregu Kryma. // Materialy VI mezhdunar.nauchnoy konf. – Yalta: NBS-NNTs, 2014. – S. 91-92.

The article was received at editors 24.09.2015

Spotar E.N. Regenerative pruning peculiarities of *Nerium oleander* cultivars within South Coast of the Crimea // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 51-59.

The article highlights the problem of *Nerium oleander* ornamentality if it's used as a coppice culture on South Coast of the Crimea. It also presents results of crowns renewal after emergency regenerative pruning. Cultivars characterized by the most intensive growth and capacity to start blossoming the same year after pruning were marked out as well.

Key words: *plant condition; level of frozing up; Nerium oleander* L.; *regenerative pruning; renewal; renewal shoots.*