

**Maksimov A.P., Plugatar Yu.V., Spotar G.Yu., Novikova V.M. Growth and development peculiarities of *Sabal minor* (Jacq.) Pers. in Nikita Botanical Gardens // Bull. Nikit. Botan. Gard. – 2016. – № 118. – P. 5-16.**

The article presents history of *Sabal minor* (Jacq.) Pers. introduction in Nikita Botanical Gardens and distribution of this cultivar along South Coast of the Crimea. It contains data of phenological observations and average quantitative biometric parameters of leaf growth and dying out during vegetative period. Reasons and factors causing irregular blooming and fruiting were determined in terms of the research that is poor rubbly soils and insufficient irrigation. Ornamentality of *Sabal minor* blooming and fruiting is also illustrated here. The article includes data of morphology and anatomy of seeds, embryo and endosperm. Process of seed germination and germ differentiation on root and stem part were traced back as well. At the same time the article contains recommendations in agrotechnology of *Sabal minor* cultivation under conditions of South coast of the Crimea.

**Key words:** *Sabal minor* (Jacq.) Pers., description, distribution, phenology, blooming, fruiting, morphology, anatomy, seed germination, cultivation, South coast of the Crimea

## OIL-BEARING AND MEDICINE PLANTS

UDK 581.192:633.812

### VARIABILITY AND INHERITANCE OF ESSENTIAL OIL CONTENT WITHIN ALLOTRIPLOID LAVANDULA HYBRIDS

**Valery Dmitriyevich Rabotyagov, Olga Vladimirovna Mitrophanova**

Nikita Botanical Gardens – National Scientific Centre, the city of Yalta  
298648, the Republic of Crimea, the city of Yalta, vil.Nikita  
[onlabor@yandex.ru](mailto:onlabor@yandex.ru)

#### Introduction

Selection of lavandin, perspective for manufacture as oil-bearing crop, is associated with breeding of interspecific hybrids F<sub>1</sub> on diploid level, crossing result of *Lavandula angustifolia* and *L. latifolia*. These hybrids are of great interest as they are characterized by heterosis [1, 7-10]. Lack of theoretical basis at matching of breeding pairs makes difficult directed selection and synthesis of hybrids with set properties. We consider, formation of hybrid genotype applying interspecific hybridization with induced polyploidic forms [3-5] is a quite perspective direction. Previously we need to know regularities of inheritance in such crossing combinations. Decision of this problem involved induction of amphidiploidic forms and directed crossings with detailed analysis of obtained generation to develop theoretical approaches aimed at matching of breeding pairs for crossing and prognostication of its results.

#### Objects and methods of the research

Initial breeding pairs were introduced by the following chemotypes: *Lavandula officinalis* sort Record with mass fraction of essential oil 2,1% per green weight or 5,8% per absolute dry product, sort Prima with mass fraction of essential oil 1,8% and 5,2% per dry product, Belyanka was chosen as a specimen with mass fraction of essential oil 1,6 per green weight and 4,65% per dry weight. Amphidiploid № 48 was used as a parent form with mass fraction of essential oil 2,5% per green weight or 6,7% per absolute dry weight. Interspecific crossing were carried out between amphidiploids and three sorts of *Lavandula officinalis*, hybrids, as a study results, were investigated to find out essential oil content.

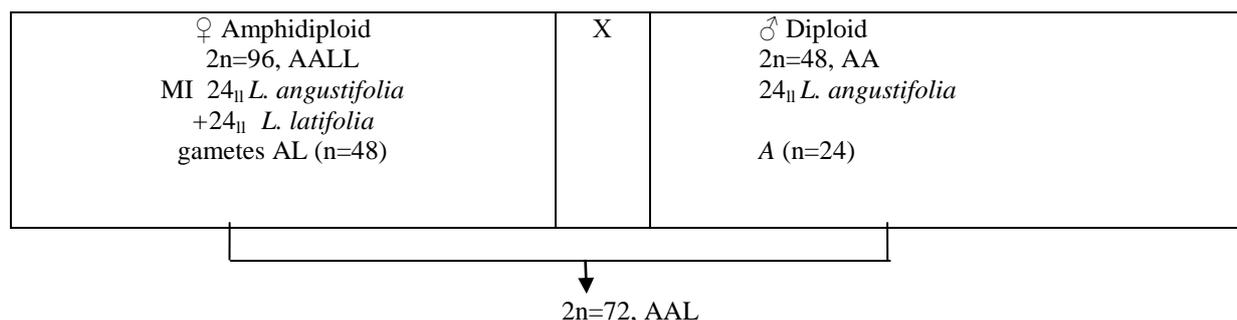
Artificial hybridization was applied to get allotriploidic hybrid F<sub>1</sub> of lavender. Morning is the most convenient time for this method. Technique of interspecific crossings involves: castration before flower opening (phase “pupa”), corolla and its stamens were

moved away by pincer. At the same time other flower buds and flowers in blossom were moved away as well. Top of the bell was cut a bit (1/3) to release stigma. After castration flower stalk with inflorescence was wrapped around with cotton and covered with parchment insulator. Pollination was carried out on the second day-third day with pollen of ripened anther of the parent plant [5, 6]. All plants, as a result of interspecific crossings were investigated to find out mass fraction of essential oil in green weight that was carried out owing to hydrodistillation of inflorescences with Clevenger apparatus, the data was converted into absolute dry mass. Experimental results were statistically processed [2].

### Results and discussions

Induced amphidiploids and diploid sorts of *Lavandula officinalis* were used in interspecific hybridization aimed at breeding of lavender hybrids with high concentration of essential oil. According to researches genetic system of amphidiploid lavender forms is characterized by high stability and capable to reproduce due to seed way. In this way only zygotes develop, that were formed owing to merging of gametes with 48 chromosomes and genomes of parent cultivars. Amphidiploid was chosen as a parent plant.

Hybrid genomes, as a result of crossing of *Lavandula officinalis* amphidiploid and diploid, have got somatic number of chromosomes  $2n=72$ , including 2 genomes of *Lavandula angustifolia* (AA) and one genome of *L. latifolia* (genome composition AA-L); they are considered as allotriploides. Their formation is presented in the scheme below:



**Crossing combination: Amphidiploid x Record, Amphidiploid x Prima, Amphidiploid x Belyanka**

Analysis of essential oil content revealed that initial forms – sorts Record, Prima and Belyanka are contrasting according to essential oil content. Belyanka has got the lowest average parameter, but amphidiploids № 48.8 presents the highest one. Interval of variation is strictly differentiated (table 1), degree of this parameter changeability is insignificant. It should be noted that initial forms considerably differ either by average or extreme characters. The most significant difference was registered according to its minimal content (table 1).

Hybridization of amphidiploid and diploid sorts and all its combinations combinations causes increasing of interval and degree of essential oil content changeability, where heterotic forms are possible to reveal. In this way parameter of heterotic effect is determined by its content of parent form. So, applying high-oil sort Record as a parent plant, heterotic effect makes 196%, while in case with Belyanka it is 117%.

Table 1

**Concentration of essential oil of parent forms and hybrids F<sub>1</sub>**  
(% per absolute green weight)

Sort, clone, hybrid	Average concentration $\bar{x} \pm Sx$	Variation limits	Coefficient of variation
<i>L. angustifolia</i> – Record	5,8±0,2	5,4-6,2	4,2±0,4
<i>L. angustifolia</i> - Prima	5,2±0,2	4,8-5,5	5,6±0,6
<i>L. angustifolia</i> - Belyanka	4,65±0,2	3,5-5,2	5,1±0,6
Amphidiploid №48	6,7±0,9	6,4-6,9	5,6±0,7
Amphidiploid x Belyanka	7,1±1,2	3,75-9,5	35,3±4,8
Amphidiploid x Prima	7,5±1,1	4,5-9,5	30,0±3,4
Amphidiploid x Record	7,8±1,2	5,0-10,5	23,5±2,8

Therefore we can fix influence of parent form on heterotic effect. Comparison investigation of crossing combinations revealed that percentage of plants with heterotic effect gets 70% maximum in crossing combination (Amphidiploid x Record), but in combination Amphidiploid x Prima it reaches only 50%, while minimum parameter was registered in combination Amphidiploid x Belyanka – 25,7% (table 2).

Table 2

**Inheritance character of essential oil content of interspecific hybrids F<sub>1</sub>** (% from the total amount of plants in each crossing combination)

Type of inheritance	Crossing combination		
	Amphidiploid 48 x Record	Amphidiploid 48 x Prima	Amphidiploid 48 x Belyanka
Exceeded parameters of the best parent plant	70,0	50,0	25,7
Equal to parameters of the best parent plant	13,3	18,0	34,3
Intermediate	10,0	14,3	31,4
Equal to parameters of the worst parent plant	5,0	10,7	5,6
Lower than parameters of the worst parent plant (depression)	1,7	7,0	3,0

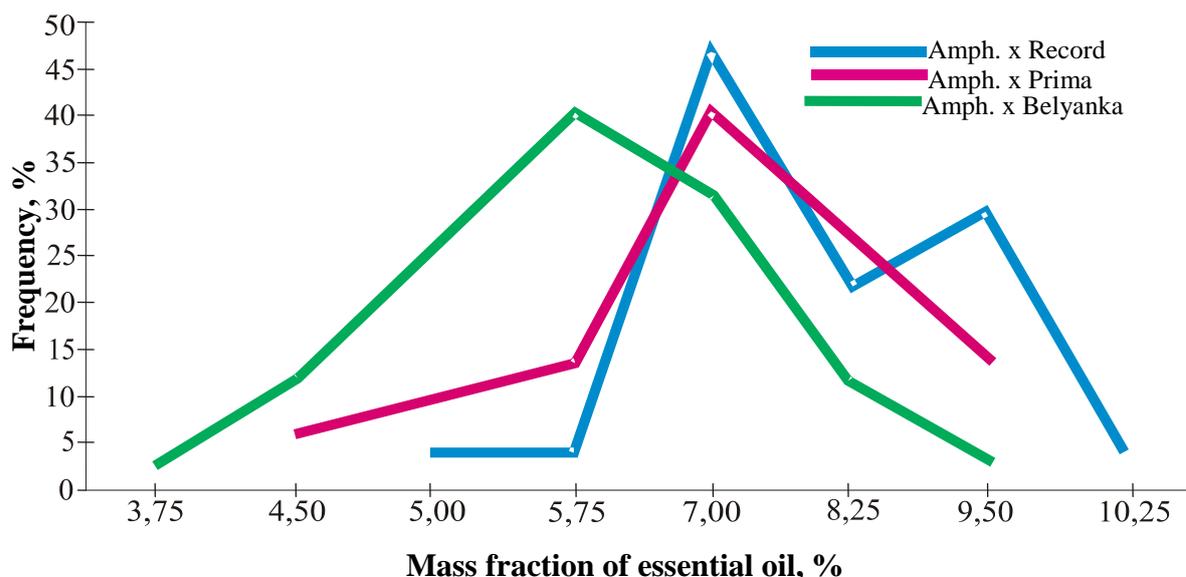
Investigations clearly revealed essential oil content of parent forms effects on possibility of hybrids with heterosis (see table 2). Than higher essential oil concentration than more heterotic hybrids as a result. But in the third crossing combination a number of hybrids with essential oil content, like best parent form has, increased significantly: accordingly 34,3%, while in the third crossing combination it makes 18%, in the first – 13%.

High essential oil capacity of hybrids in crossing combination (Amphidiploid x Record) was probably grounded by genetic characteristics of parent forms; in particular they possess wide spectrum of changeability of essential oil concentration in case of self-pollination, what indicates their heterozygosis. Heterozygous character of initial hybrids determines effect of heterosis, what improves sampling opportunity of hybrids with high essential oil concentration.

Figure 1 presents comparison of different crossing combinations concerning essential oil content. There is distribution of allotriploid hybrids according to essential oil mass fraction. Distribution curve of hybrids in crossing combination Amphidiploid x Belyanka is regular. Variation interval of essential oil mass fraction is shifted to both sides with the lowest concentration (3,75%) as a result depression signs and to the side with the high concentration (9,5% per absolute green weight). Hybrids are concentrated in the interval with essential oil content from 4,5% to 7% and makes 71,4% from the total amount of plants. A

number of plants with essential oil content from 7,0 till 8,25% makes 11,4% and only one hybrid possesses essential oil concentration 9,4%.

In the crossing combination (Amphidiploid x Prima) distribution curve is regular as well, but shifted to the side with high essential oil concentration. Variation interval of content ranges from 4,5% till 9,5%. The principal mass of lavender allotriploid hybrids is located in the interval from 5,75 till 8,25% and makes 80% of the total amount of hybrids. It should be noted in this crossing combination hybrids with high essential oil concentration were successfully resulted in the range from 8,25% till 9,5%, what improves sampling of hybrids with high essential oil concentration (fig.1).



**Fig. Distribution of interspecific hybrids  $F_1$  according to essential oil concentration in different crossing combinations**

The most successful sampling of breeding pairs aimed at selection of allotriploid hybrids with high essential oil mass fraction was Amphidiploid 48.8 x Record). The way of hybrids distribution by essential oil content is presented at figure. In this way variation interval extends to the side of higher parameters. Hybrids in the variation interval of essential oil mass fraction from 8, 25% till 10,25% are of great interest for breeding and makes 25% of the total amount. There is a high possibility of heterotic hybrids. In this crossing combination hybrids with the highest content of essential oil (10,0% and 10,25% per absolutely dry product) were successfully synthesized, what is of great interest for breeding.

In crossings of allotriploids and *Lavandula officinalis* (sorts Record and Prima) there is an opportunity to synthesize considerable heterotic effect with high possibilities to sample allotriploids with high essential oil content in hybrid generation.

### Conclusions

Investigation of breeding pairs ability to be combined, aimed at selection of hybrids with high essential oil content revealed, it demands directed interspecific crossings within combination of amphidiploids with *L. angustifolia*, sort Record, what will make it possible to synthesize allotriploids with two genomes of *L. angustifolia* and one genome of *L. latifolia* up to 3,6% with essential oil mass fraction of 9,9% and 10,25%.

The work was granted by the Russian Scientific Foundation (project № 14-500079).

### References

1. Akimov Yu.A., Rabotyagov V.D. Vnutrividovaya i vnutriklonovaya izmenchivost efirnogo masla u *L. angustifolia* i *L. latifolia* pri semennom razmnzhenii // Rast.resursy. – 1987. - № 3. – S. 417.
2. Dospikhov V.A. Metodika poevogo opyta. – M.: kolos, 1975. – 424s.
3. Rabotyagov V.D. Problema synteza lavandina. // Tr. Gos. Nikitskogo botan.sada. – 1983. – T. 91. S. 92.
4. Rabotyagov V.D. Preodoleniye sterilnosti u lavandina (*L. angustifolia* i *L. latifolia*) // Tsytologiya i genetika. – 1975. – T.9. - №5. – S. 443.
5. Rabotyagov V.D., Akimov Yu.A. Nasledovaniya sodержaniya i sostava efirnogo masla pri mezhvidivoy hybridizatsii lavandy // Genetika. – 1986. – T. 22. № 7. – S.1163.
6. Shoferistov Ye.G., Rabotyagov V.D., Mashanov V.I. Organogenez i biologiya tsveteniya lavandy i lavandina // Botan.journ. – 1977. – T. 62. – S. 1479.
7. Mala V.D., Beck A. et al. La selection du Lavandin // Riv. Ital. 1981. V.63. №3. P.163.
8. Martin C., Zola A. Etude sur de nouvelles varieties de Lavandin // Riv. Ital. 1973.
9. Paris R., Dillemann W. Le Problime du Lavandin et les lois de L<sup>^</sup>Hybridation // La France et ses Parfums, 1959.№13. P.14.
10. Tucker A.O., Hensen K.L.W. The cultivars of Lavander and Lavandin (Labiata / e) // Bailey. 1985. V.22. №4. P.168.

*The article was received at editors 18.11.2015*

**Rabotyagov V.D., Mitrophanova O.V. Variability and inheritance of essential oil content within allotriploid *Lavandula* hybrids** // Bull. Nikit. Botan. Gard. – 2016. – № 118. – P. 16-20.

The article concerns the problem of breeding pairs fitting according to synthetic selection of allotriploid *Lavandula* hybrids with two genomes (*Lavandula angustifolia* Mill) and one (*L. latifolia* Medic) having high concentration of essential oil. There are comparison data of essential oil mass fraction in synthesized allotriploids as a result of crossing of introduced amphidiploid and *Lavandula officinalis* L. cultivars. Mechanisms of mass fraction variability and inheritance of hybrids – results of different crossing combinations – are discussed in terms of the research as well. Heterotic interspecific hybrids with 10,0% and 10,25% from the total dry material were obtained in course of the study.

**Key words:** *Lavandula*; allotriploid; amphidiploids; heterosis; essential oil mass fraction; crossing combination.