GENETIC AND BREEDING UNIQUENESS OF F_1 REMOTE HYBRID *VACCINIUM ULIGINOSUM* L. × *VACCINIUM VITIS-IDAEA* L.

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Introduction

The first lingonberry cultivars in the world were produced abroad (the Netherlands, Germany) by selecting initial natural forms and have a number of disadvantages. A classical method of breeding – remote hybridization was not practically tested in this object and some attempts did not give hopeful results since sterility of interspecific hybrids was not overcome. As a rule, breeders use a polyploidy phenomenon, insufficiently known in lingonberry, for developing fertile hybrid plants. This made us pursue combined investigations on breeding fertile hybrid forms of lingonberry with a constitution corresponding to growing conditions of a cultivated crop.

One of the research results on breeding improvement of *V. vitis-idaea* using the remote hybridization method was the development of some forms of the F_1 generation in the crossing combination *V. uliginosum*× *V. vitis-idaea* where the initial species were represented by tetraploids. Plants of the lingonberry x bog bilberry hybrid were produced by crossing aboriginal bog bilberry (forest ecobiomorph) and lingonberry introduced in Belarusan Polessie from natural flora of the Kolyma upland region (Russia). Отметим, что проращивание гибридных семян в данной комбинации скрещивания, равно как и полученных в экспериментах по скрещиванию *V. uliginosum* × *V. vitis-idaea* с видами *Vacciniaceae* осуществлялось с применением традиционной методики, при этом высевали семена выделенные из свежесобранных ягод и не прошедшие этапа длительной холодовой стратификации (Морозов, 2000; Морозов, 2003).

It should be noted that we managed to find only one very short mention of a supposed natural bog bilberry × lingonberry hybrid named *V. uliginosum* L. var. *splendens* Rupr. (Авторин, 1958). In later and modern literature, no new information corroborating the existence of this plant was found.

Results and discussion

Genetic uniqueness of the hybrid is due to the fact that we managed to overcome a number of non-crossability barriers between *V. uliginosum* and *V. vitis-idaea*, in particular with lingonberry as father and bog bilberry as mother when conducting the given crossing at the tetraploid level:

1. Local character of the detected tetraploid lingonberry micropopulation growing apart with respect to bog bilberry brake, as well as small numbers of its individuals (Морозов, 1995);

2. Geographic isolation of lingonberry – and bog bilberry tetraploids that is caused by territorial differentiation, peculiar to the latter species, into populations with a different ploidy level. In the northern part of the bog bilberry area, in particular in the Magadan region (where tetraploid lingonberry was found) and on the boundary between mountain forest and subalpine belts of its southern part, a dip-

loid (2n=24) form of this species grows and in temperate latitudes of the European continent (Belarus), where the existence of tetraploid lingonberry micropopulations was not established (diploids occur everywhere), its tetraploid (2n=48) variety grows (Дмитриева, 1985);

3. Spatial microisolation. Suppose tetraploid lingonberry still grows in Belarusan forests, then under its cohabitation with bog bilberry having a similar ploidy level the latter forms the upper layer of a grass-low shrub community and lingonberry does the lower one. Thus, the most probable variant of hybridization in natural habitats would be pollination of lingonberry stigma by pollen from bog bilberry but not a reciprocal crossing combination.

4. Genetic incompatibility. Our repeated attempts to develop *V. vitis-idaea* × *V. uliginosum* amphidiploid never led to a positive result – no seeds were formed and in the case of pollinating the style section even berries did not set (see Table in the previous article) that indicates a high degree of incompatibility between lingonberry and bog bilberry in the given crossing combination. Hybridization of aboriginal forms of diploid lingonberry and tetraploid bog bilberry performed earlier in the same crossing combination proved unsuccessful – only one adult plant with a lingonberry phenotype was produced (Морозов, 1990). Lack of geographic isolation of diploid lingonberry (mother) and tetraploid bog bilberry (father) (see item 2) in temperate latitudes as well as of spatial microisolation of reproductive systems of these plants (see items 3) is a cause to consider genetic incompatibility, intensified by a polyploid barrier, a major obstacle even for their spontaneous hybridization under natural conditions.

Breeding uniqueness of the remote F_1 hybrid V. uliginosum × V. vitis-idaea is attributed to two features:

1. A good combination of quite a number of traits and properties, important in cultivation: deep location of root system, spatial and structural discreteness of a vital form, good growth and habitus of bushes, vigorous regeneration of overground vegetative organs, defoliation, early terms of berry ripeness (Морозов, 2004).

2. A high degree of genetic compatibility with Vacciniaceae species and a good quality of not only female gametophyte (Fig. 1) but also of male one (Fig. 2, see Fig. 1) distinguishing it among absolutely sterile or only partly fertile hybrids of the F_1 generation produced, as a rule, in experiments on remote hybridization, as well as disposition to self-fruiting intensified by the morphological structure of a flower (pistil stigma is placed close to pollen tubes) (Морозов, 2004).

Genetic compatibility, fertility and self-fruiting of the hybrid favour the development of viable offspring mass material of different variants by open pollination, backcrossing and step-by-step crosses (see Fig. 1). That is to say, for the first time in lingonberry breeding the possibility of full-scale application of the genetic potential of Vacciniaceae species is provided by the remote hybridization method. This will allow detection of really hybrid plants and creation of prerequisites for synthesis of genotypes with the given parameters adequate to crop conditions that is one of the most important factors of the progress not only in the hybridization experiment, as in one of particular breeding trends, but also in breeding of lingonberry in general.

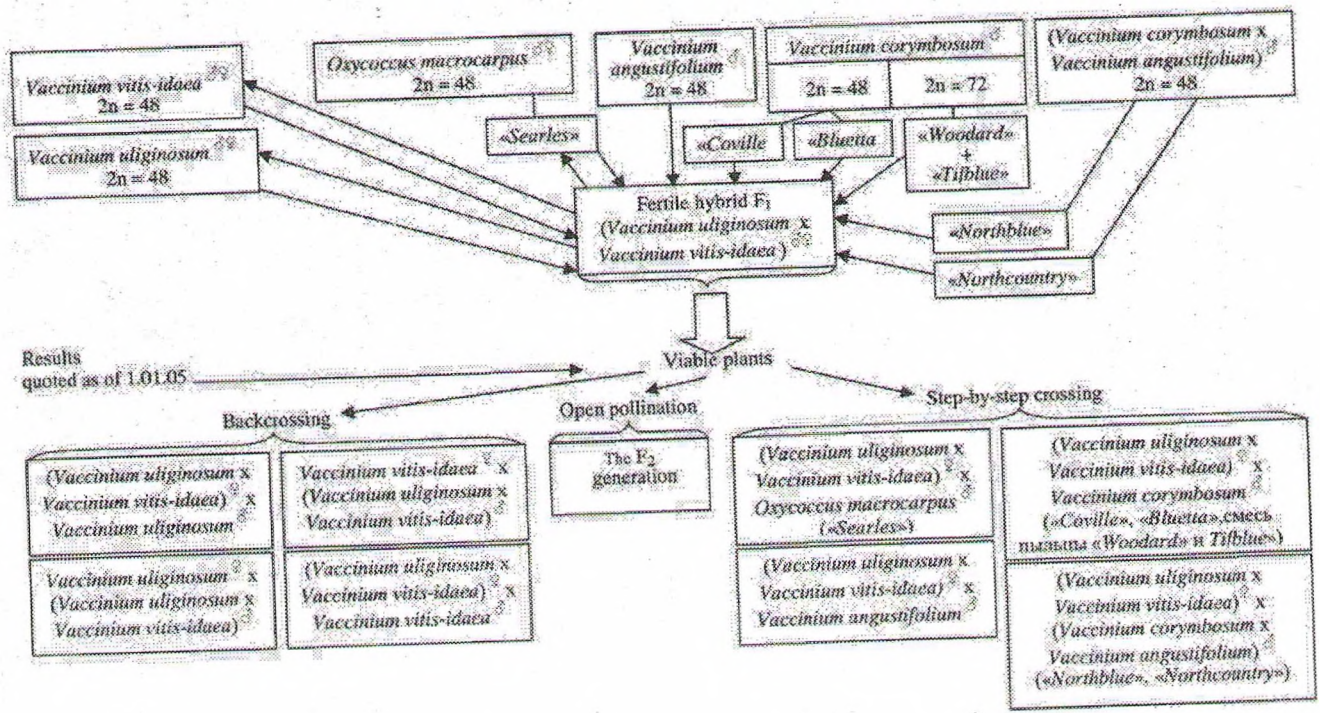

Fig 1. **Sheme and experimental results on hybridization of F_1 *V. uliginosum*♀×*V. Vitis-idaea*♂ allotetraploid (2002-2004 years)**

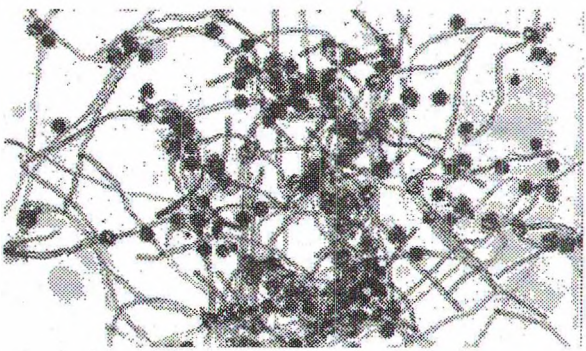

Fig. 2. **Pollen of the F_1 hybrid *V. uliginosum* × *V. vitis-idaea* (G2 form) that has germinated in 10 % saccharose solution**

Effective, as a rule, application of the F_1 *V. uliginosum* × *V. vitis-idaea* allotetraploid, at least at the stage of producing viable plants, compensates for a slight range of genetic compatibility in tetraploid *V. vitis-idaea* (see the previous article). This increases lingonberry breeding potentialities by artificial form development and is an original technique for overcoming its non-crossability with geographically and taxonomically remote *Vacciniaceae* species, in particular with representatives of the agronomically important group of North-American bilberry (*Cyanococcus* section) of a different ploidy level (2n=48, 2n=72) (see Fig. 1), many species, cultivars and forms of which have shown a good performance when introduced in various countries of the world including Belarus too.

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ГЕНЕТИЧЕСКАЯ И СЕЛЕКЦИОННАЯ УНИКАЛЬНОСТЬ ОТДАЛЕННОГО ГИБРИДА F_1 *VACCINIUM ULIGINOSUM* L. × *VACCINIUM VITIS-IDAEA* L.

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Резюме

Генетическая уникальность впервые созданного нами отдаленного гибрида (аллотетраплоида) F_1 *V. uliginosum* (голубика топяная) × *V. vitis-idaea* (брусника обыкновенная) обусловлена тем, что удалось преодолеть ряд барьеров нескрещиваемости между родительскими видами, в частности в направлении брусника обыкновенная – отец, голубика топяная – мать при осуществлении данного скрещивания на тетраплоидном уровне, использовав при этом традиционную методику проращивания семян, не прошедших этапа длительной холодовой стратификации.

Селекционная уникальность данного гибрида обусловлена удачным сочетанием ряда хозяйственно значимых при культивировании признаков и свойств, а также высокой степенью совместимости с видами брусничных, склонностью к самоплодности и хорошим качеством не только женского гаметофита, но и мужского, что выделяет его среди абсолютно стерильных или лишь частично фертильных гибридов поколения F_1, как правило получаемых в экспериментах по отдаленной гибридизации.

Выведение уникального в генетическом и селекционном отношениях бруснично-голубичного гибрида является предпосылкой успешного решения основной селекционной проблемы брусники обыкновенной – увеличения резерва комбинационной изменчивости, в частности, за счет создания генофонда отдаленных (трехвидовых) гибридов видов брусничных и может рассматриваться в качестве реальной основы расширения ассортимента кустарниковых ягодных растений культурной флоры.