COMPATIBILITY OF *VACCINIACEAE* SPECIES WITH TETRAPLOID *VACCINIUM VITIS-IDAEA* L. AT REMOTE HYBRIDIZATION

O.V. MOROZOV
Central Botanical Gardens at National Academy of Sciences of Belarus, Surganov st. 2B, Minsk, Belarus

Introduction

A particularly important problem of lingonberry breeding by remote hybridization is the study on the possibility of producing really hybrid genotypes of plants by crossing its tetraploid forms (2n=48) (Морозов, 1995) with other *Vacciniaceae* species of a similar ploidy level.

Representatives of aboriginal flora were involved in this crossing: *O. palustris* and *V. uliginosum*, as well as cultivated introducers from North America occurring frequently and exhibiting a complex of agronomic traits: *V. corymbosum* (cvs «*Coville*» and its seedlings, «*Rancocas*», «*Herbert*»), *V. angustifolium*, *O. macrocarpus* (cv. «*Searles*») (Table). Lowbush blueberry plants were grown from seed blend of Canadian cultivars: K510, ME3, K508, K70–62, kindly given to us by T.V. Paal, a researcher from Estonia. Tetraploid American cranberry (grafts) was kindly supplied by the colleagues from Finland (Lehmushovi et al., 1993). We would remind you that diploid F_1 hybrids *V. vitis-idaea* × *O. macrocarpus* developed by us earlier were sterile but exhibited a number of agronomic traits and properties of vegetative organs (Морозов, 1993). Testing various crossing combinations by using large genetic diversity has given us an opportimity to reveal the most compatible combinations.

Results and discussion

Relatively good fruit setting and obtaining of a great number of normally developed seeds indicated originally the prospects of the *V. vitis-idaea* × *O. palustris* crossing combination as well as of reciprocal crossing between lingonberry and highbush blueberry (see Table). However, the morphological analysis of adult individuals has shown that absolutely the entire material of the F_1 generation in the above-stated combinations had the phenotype of maternal plants. Some heteromorphism of traits, peculiar to juvenile F_1 individuals of *V. corymbosum* × *V. vitis-idaea*, is accounted for, in our opinion, by a complicated genome constitution of *V. corymbosum* cultivars. With an increase in the seedling age differences in their appearance smooth over to a certain extent but it remains evident that we deal, nevertheless, with individuals of segregated highbush blueberry.

Based on the results obtained, it is concluded that there exists a very high degree of genetic incompatibility of crossed plants. When pistil stigma is pollinated, berries with good plump seeds, which successfully germinate, are formed. As a result, plants with a maternal phenotype are produced that may be accounted for by stimulating apomixis. One of spermatozoa fuses with a central diploid cell of the embryo sac stimulating normal development of cotyledons and doubling of the chromosome number in a haploid egg takes place without fertilization by the second spermatozoon. But it may happen that the incompatibility barrier is located in the upper part of the style but not in ovary, and a geitonogamy or a xenogamy type of pollination takes place instead of realization of controlled crosses. In considera-

tion of this circumstance, the experimental conditions were changed in some crossing combinations, the most interesting and promising in our opinion.

Tabl. **Results of crosses between *Vacciniaceae* tetraploid species, cultivars and forms and tetraploid *V. vitis-idaea***

Combination		No of pollinated flowers	Manner of pollination	No of produced berries	% of the number of pollinated flowers as berries	No of produced seeds
♀	♂					
V. vitis-idaea	*O. palustris*	325		38	11,7	125
		271		42	15,5	172
O. palustris	*V. vitis-idaea*	110		2	1,8	0
		131		3	2,3	1
V. vitis-idaea	*O. macrocarpus* («*Searles*»)	30		1	3,3	2
O. macrocarpus («*Searles*»)	*V. vitis-idaea*	132		4	3,0	7
V. vitis-idaea	*V. uliginosum*	291		2	0,7	0
		224		3	1,3	0
V. uliginosum	*V. vitis-idaea*	160		27	16,9	261
		105		17	16,2	78
		915		25	2,7	258
V. vitis-idaea	*V. corymbosum* («*Coville*»)	50	Pollination of pistil stigma	4	8,0	10
V. vitis-idaea	*V. corymbosum* («*Coville*» + «*Herbert*»+ «*Rancocas*»)	250		12	4,8	49
V. corymbosum («*Herbert*»)	*V. vitis-idaea*	422		93	2,2	152
V. corymbosum («*Rancocas*»)	*V. vitis-idaea*	230		10	4,3	67
		989		386	39,0	1668
V. corymbosum («*Coville*» seedlings)	*V. vitis-idaea*	210		13	6,2	35
V. vitis-idaea	*V. angustifolium*	191		2	1,0	5
V. angustifolium	*V. vitis-idaea*	316		7	2,2	10
V. corymbosum («*Coville*»)	*V. vitis-idaea*	128		51	39,8	0
V. corymbosum («*Rancocas*»)	*V. vitis-idaea*	261	Pollination of style section	110	42,1	0
V. corymbosum («*Herbert*»)	*V. vitis-idaea*	220		108	49,1	0
V. vitis-idaea	*V. uliginosum*	222		0	0	0

So, immediately before carrying out artificial pollination of *V. corymbosum* cultivars, the style was removed with a blade in emasculated flowers and a horizontal section was pollinated (see Table). It was assumed that in this case the controlled crossing should occur in the absence of «incompatibility matter» (Палилов и др., 1981). As it turned out, berry setting was good, berry reached the ripeness stage and did not differ in the appear-

ance from ordinary *V. corymbosum* fruits. However, no plump seeds were formed in any berry in contrast to the variant by pollinating pistil stigma (see Table). It would be logical to assume that the removal of a style part favoured reaching of *V. corymbosum* ovary by *V. vitis-idaea* gametes which reached it very quickly, prior to ingress into the section and germination of pollen from maternal plant flowers. Due to pronounced genetic incompatibility of crossing components, no spermatozoon fusion with the central cell of the embryo sac and the egg happened that resulted in complete elimination of cotyledon and embryo structures with simultaneous stimulation of ovary growth. It follows from the above-mentioned that the incompatibility barrier is most likely located in the upper part of the style. When pistil stigma of highbush blueberry is pollinated with lingonberry pollen (pistil stigma of lingonberry is pollinated with highbush blueberry pollen, pistil stigma of lingonberry is pollinated with European cranberry pollen), autogamous mating occurs instead of artificial hybridization. This results in formation of the offspring with the phenotype of a maternal species.

Crossing between lingonberry and *V. angustifdolium* also failed to develop hybrids since the produced scanty seeds proved nongerminating in spite of their good plumpness.

In the experimental variants with pollination of pistil stigma in the *V. vitis-idaea* x *V. uliginosum* combination, sole produced berries turned out seedless. In the experiment with pollination of the style section in the above combination no berries set (see Table). These facts, in our opinion, indicate even more considerable degree of incompatibility than between *V. vitis-idaea* and *V. corymbosum* cultivars, *V. vitis-idaea* and *V. angustifolium*. At the same time just backcrossing between lingonberry and bog bilberry proved the most successful from all the tested variants of remote hybridization of tetraploid lingonberry – the remote F_1 hybrid *V. uliginosum* x *V. vitis-idaea*, that is promising for future breeding, was developed (Морозов, 2004).

Since reciprocal crosses between *V. vitis-idaea* and *V. corymbosum* and *V. vitis-idaea* and *V. angustifolium* have not resulted in a success, reciprocal crosses of the F_1 hybrid *V. uliginosum* × *V. vitis-idaea* with *V. corymbosum* and *V. angustifolium* will be of interest in future. It is associated with the fact that repeated production of the F_1 genetic hybrids of *V. corymbosum* and *V. uliginosum* (Czesnik, 1985; Hiirsalmi and Lehmushovi, 1982; Hiirsalmi, 1988) as well as genetic relationship between *V. corymbosum* and *V. angustifolium* (Vorsa, 1997) increases the probability of a positive result at least in one of these variants.

Conclusions

The question of genetic compatibility of tetraploid lingonberry and American cranberry in the *V. vitis-idaea* × *O. macrocarpus* combination is left open – two produced plants are characterized by so delayed development that it is impossible to determine their hybridity even by the phenotype of the 2-year individuals. Scanty seeds turned out nongerminating in the reciprocal variant of the given combination.

References

Марозаў А.У. Аўтатэграплоіды *Vaccinium vitis-idaea* L. у прыродных умовах // Весці АН Беларусі. Сер. біял. навук. 1995. №2. С. 5–11.

Lehmushovi A., Hokkanen H.& Hiirsalmi H. Cranberry breeding in Finland // Acta Horticulturae: *Vaccinium* culture V. 1993. №346. P. 322–326.

Марозаў А.У. Біёлага-марфалагічная характарыстыка гібрыдаў F1 *Vaccinium vitis-idaea* L. × *Oxycoccus macrocarpus* Pursch // Весці АН Беларусі. Сер. біял. навук. 1993. №2. С. 18-24.

Палилов А.И., Хотылева Л.В., Савченко А.П., Корпусенко Л.И., Анохина Т.А., Полканова Т.П., Данилов А.С. Полиморфизм растений по степени перекрестноопыляемости. – Минск: Наука и техника, 1981. 248 с.

Морозов О.В. Основные биологические признаки и свойства бруснично-голубичного гибрида F_1 (*Vaccinium uliginosum* × *Vaccinium vitis-idaea* L.) // Весці НАН Беларусі. Сер. біял. навук. 2004. № 3. С. 7-23.

Hiirsalmi H. Small fruit breeding in Finland // J. of Agric. Sci. in Finl. 1988. Vol.60, №4. P. 223-234.

Горбунов А.Б., Снакина Т.И. Межвидовая гибридизация – перспективное направление при введении в культуру голубики топяной // Состояние и перспективы развития редких садовых культур в СССР. Мичуринск, 1989. С. 100-103.

Hiirsalmi H., Lehmushovi A. A finnish highbush blueberry variety 'Aron' // Annal. Agric.Fen. – 1982. №50, Vol.21. P. 151-154.

Czesnik E. Investigation of F_1 generation of interspecific hybrids *Vaccinium corymbosum* L. × *Vaccinium uliginosum* L. // Acta Horticulturae: *Vaccinium* culture. 1985. №165. P. 85-91.

Vorsa N. On a wing: the genetics and taxonomy of *Vaccinium* species from a pollination perspective // Acta Horticulturae: *Vaccinium* culture. 1997. № 446. P. 59-66.

СОВМЕСТИМОСТЬ ВИДОВ БРУСНИЧНЫХ ПРИ ОТДАЛЕННОЙ ГИБРИДИЗАЦИИ С ТЕТРАПЛОИДНОЙ *VACCINIUM VITIS-IDAEA* L.

О.В. МОРОЗОВ

Резюме

Принципиально возможным является создание жизнеспособных и фертильных гибридов скрещиванием тетраплоидной *V. vitis-idaca* с видами брусничных аналогичного уровня плоидности. Отсутствие же положительного результата в той или иной комбинации скрещивания обусловлено препятствиями генетической природы, иногда одностороннего характера (*V. vitis-idaea* × *V. uliginosum*), существующими между родственными, но значительно дивергировавшими в ходе эволюции или в результате искусственного синтеза таксонами. Высокой степенью реципрокной несовместимости характеризуются *V. vitis-idaea* и сорта *V. corymbosum*, а также *V. vitis-idaea* и *V. angustifolium*, *V. vitis-idaea* × *O. palustris*.