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HYBRIDIZATION IN THE GENUS VIOLA.

By M. O. MALTE AND J. M. MACOUN.

(Continued from page 150).

As, however, the cleistogamous flowers are developed comparatively late in the season, their failure to produce normal seed can be utilized as a means of determining the hybrid nature of critical forms only by those students who have the opportunity of studying the violets after the showy petaliferous flowers have wholly or mostly disappeared, i.e., at a time when the amateur botanist generally considers the violet season a matter of the past.

Early in the season, before the capsules of the cleistogamous flowers are beginning to ripen, the hybrid nature of suspected plants can be most satisfactorily ascertained through an examination of the pollen of their showy, petaliferous flowers, as it is not only the sexual cells of the cleistogamous flowers which are affected by hybridization, but also those of the petaliferous ones. In other words, the whole sexual apparatus of a hybrid plant, including both male and female organs, is conspicuously deteriorated and incapable of normal functions.

The stamens of a violet flower have, as is well known, very short filaments, sometimes hardly visible to the naked eye. Their anthers, on the other hand, are broad and composed of two cells, separated by a rather conspicuous connective. The latter carries on its top a peculiar appendage which is generally brown or reddish brown. The anthers proper, that is to say, the portion of the stamens below the appendages, are placed close together and have the appearance of a cupola, from the centre of which emerges the pistil. In their cells they carry numerous pollen grains which, when normally developed, appear more or less triangular, quadrangular, or elliptic, depending upon the species and also on from which side they are viewed.

The pollen grains of a stamen taken from a plant belonging to a good species, are all uniform as to size and general appearance. When examined in a drop of water under a microscope magnifying 200 to 500 times they appear opaque and of a dull grayish colour, owing to the fact that they are filled with a rich and slightly granulated protoplasma.

The opaque appearance of the pollen grains and also their uniformity are characters which can be observed not only on living plants but also on pressed material which has been kept dry for many years.

The appearance of the pollen, developed by a hybrid plant, is quite different. In the first place, the pollen grains are far from uniform in size and shape. Only a few reach the size of those of a good species, the majority being much smaller. They appear irregular in outline, are often shrunken and always of a bright colour. Examined under a microscope with a low magnification, say 100 times, the pollen from a hybrid violet gives an impression of emptiness and sexual incapacity. Examined under higher magnification, most of the pollen grains prove really, to be empty or filled with a watery content. Even those grains which, under lower magnification, appear to be fairly normal, prove to be filled with a very poor and watery protoplasma, and are therefore almost transparent.

The percentage of good sized grains in pollen of violet hybrids varies with the combination of the hybrid. The closer the species from which a hybrid has been formed are related to each other, the less degenerated becomes the pollen of the hybrid. Those hybrids, however, which are formed from systematically widely separated species, have an extremely poor pollen, the percentage of evidently wholly useless pollen grains often running as high as 95 per cent or more.

The sterility of the pollen in the petaliferous flowers of hybrid violets is, briefly, just as marked as the sterility of the capsules of the cleistogamous ones and consequently furnishes an equally excellent means whereby, in doubtful cases, the hybrid nature of violet plants can be ascertained.

The fact that hybrids between distinct species of violets show reduced sexual capability, should evidently be of great assistance to students endeavouring to reach a clear understanding of the systematic relationships of closely allied forms, inasmuch as the sterility or fertility of intermediates between such forms may decide whether the forms in question represent distinct specific units or merely are varieties of one species.

This question will, however, not be further discussed in the present paper.

The following is a list of violet hybrids which so far have been recorded in North America.

- V. affinis* x *Brittoniana* Dowell, Bull. Torr. Bot. Club. 37, 169.
 “ x *cucullata* Brainerd, Rhodora 8, 49.
 “ x *fimbriatula* Dowell, Bull. Torr. Club. 37, 170.
 “ x *hirsutula* Dowell, Bull. Torr. Bot. Club. 37, 171.
 (= *V. affinis* x *villosa* Brainerd, Rhodora 8, 56.)
 “ x *nephrophylla* Brainerd, Rhodora 8, 50.
 “ x *palmata* Dowell, Bull. Torr. Bot. Club. 37, 171.
 “ x *papilionacea* House, Rhodora 8, 119.
 “ x *sagittata* Brainerd, Rhodora 8, 55.
 “ x *septentrionalis* Brainerd, Rhodora 6, 219.
 “ x *sororia* Brainerd, Rhodora 6, 221.
- V. Brittoniana* x *cucullata* House, Bull. Torr. Bot. Club. 32, 255.
 (= *V. notabilis* Bickn. Torrey 4, 131).
 “ *V. cucullata* x *septomloba* Brainerd, Rhodora 8, 52.)
 “ x *emarginata* House, Rhodora 8, 120.
 (= *V. emarginata* x *septomloba* Brainerd, Rhodora 8, 53.)
 “ x *fimbriatula* Dowell, Bull. Torr. Bot. Club. 37, 172.
 (= *V. Mulfordæ* Poll. Proc. Soc. Biol. Wash. 15, 203).
 “ *V. fimbriatula* x *septomloba* Brainerd, Rhodora 8, 51.)
 “ x *lanceolata* Forbes, Rhodora 11, 15.
 “ x *palmata* nom. nov.
 (= *V. palmata* x *septomloba* Brainerd, Rhodora 8, 55).
 “ x *papilionacea* Dowell, Bull. Torr. Bot. Club. 37, 173.
 “ x *sagittata* House, Rhodora 8, 120.
 (= *V. sagittata* x *septomloba* Brainerd, Rhodora 8, 51.)
 “ x *sororia* Dowell, Proc. Staten Isl. Ass. 3, 162.
- V. cucullata* x *fimbriatula* Brainerd, Rhodora 6, 217.
 (= *V. Porteriana* Poll., Bull. Torr. Bot. Club. 24, 404).
 “ x *nephrophylla* Brainerd, Rhodora 8, 50.
 “ x *palmata* Brainerd, Rhodora 15, 115.
 (Not *V. cucullata* x *palmata* Brainerd, Rhodora 8, 56. which is *V. cucullata* x *triloba* Brainerd, Rhodora 15, 115.)
 “ x *papilionacea* Brainerd, Rhodora 8, 56.

- V. cucullata* x *primulifolia* Brainerd, Rhodora 11, 115.
 (= *V. lavandulacea* Bickn. Torrey 4, 130, *V. cucullata* x (?) *emarginata* Brainerd, Rhodora 8, 52.)
- “ x *sagittata* Brainerd, Rhodora 8, 52.
- “ x *septrionalis* Brainerd, Rhodora 6, 220.
 (= *V. melissaefolia* Greene, Pitt. 5, 103.)
- “ x *sororia* Brainerd, Rhodora 6, 222.
- “ x *triloba* Brainerd, Rhodora 15, 115.
 (= *V. cucullata* x *palmata* Brainerd, Rhodora 8, 56.)
- V. emarginata* x *hirsutula* nom. nov.
 (= *V. emarginata* x *villosa* House, Rhodora 8, 120.)
- “ x *papilionacea* House, Rhodora 8, 120.
- “ x *sororia* Dowell, Proc. Staten Isl. Ass. 3, 162.
- V. fimbriatula* x *hirsutula* Dowell, Bull. Torr. Bot. Club. 37, 175.
 (= *V. fimbriatula* x *villosa* House, Rhodora 8, 121.)
- “ x *palmata* Brainerd, Rhodora 15, 114.
 (Not *V. fimbriatula* x *palmata* Brainerd, Rhodora 8, 51, which is *V. fimbriatula* x *triloba*, Brainerd, Rhodora 15, 114.)
- “ x *papilionacea* Brainerd, Rhodora 8, 54.
 (= *V. papilionacea* var. *aberrans* Stone.)
- “ x *septrionalis* Brainerd, Rhodora 6, 215.
- “ x *sororia* Brainerd, Rhodora 6, 218.
- “ x *triloba* Brainerd, Rhodora 15, 114.
 (= *V. fimbriatula* x *palmata* Brainerd, Rhodora 8, 53.)
- V. hirsutula* x *palmata* Brainerd, Bull. Torr. Bot. Club. 39, 96.
 (Not= *V. palmata* x *villosa* Brainerd, Rhodora 8, 56, which is *V. hirsutula* x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 95.)
- “ x *papilionacea* Brainerd, Rhodora 9, 98. (= *V. villosa* var. *cordifolia* Nutt., *V. papilionacea* x *villosa* House, Rhodora 8, 121.)
- V. hirsutula* x *sororia* Dowell, Bull. Torr. Bot. Club. 37, 176.
- “ x *Stoneana* Brainerd, Bull. Torr. Bot. Club. 39, 96.
 (= *V. Stoneana* x *villosa* House, Rhodora 8, 121.)
- “ x *tribola* Brainerd, Bull. Torr. Bot. Club. 39, 95.
 (= *V. palmata* x *villosa* Brainerd, Rhodora 8, 56.)

V. lanceolata x *primulifolia* Dowell, Bull. Torr. Bot. Club. 37, 176.

V. latiuscula x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 94.

V. nephrophylla x *pedatifida* Brainerd, Bull. Torr. Bot. Club. 39, 94. (= *V. Wilmattæ* Poll. and Cockerell, Proc. Biol. Soc. Wash. 15, 178.)

V. oconensis x *sagittata* House, Torreyia 7, 136.

V. pallens x *primulifolia* Dowell, Bull. Torr. Bot. Club. 37, 177.

V. palmata x *papilionacea* Dowell, Bull. Torr. Bot. Club. 37, 177,
" x *sagittata* Brainerd, Rhodora 15, 115.

(Not *V. palmata* x *sagittata* Brainerd, Rhodora, 8, 54, which is *V. sagittata* x *triloba* Brainerd, Rhodora 15, 115.)

" x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 88.
(= *V. Angellæ* Poll., Torreyia 2, 24, *V. palmata* var. *Angellæ* (Poll.) Stone, Proc. Acad. Phila. 1903, 678.)

V. papilionacea x *pedatifida* Brainerd, Bull. Torr. Bot. Club. 40, 249.

" x *sagittata* Brainerd, Rhodora 8, 54.

" x *sororia* Dowell, Bull. Torr. Bot. Club. 37, 178.

" x *Stoneana*, Brainerd, Bull. Torr. Bot. Club. 39, 93.

" x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 90.

V. pedatifida x *sagittata* Brainerd, Bull. Torr. Bot. Club. 40, 252.

" x *sororia* Brainerd, Bull. Torr. Bot. Club. 40, 253.

V. sagittata x *triloba* Brainerd, Rhodora 15, 115.
(= *V. palmata* x *sagittata* Brainerd, Rhodora 8, 54.)

V. septentrionalis x *sororia* Brainerd, Rhodora 6, 221.

V. sororia x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 92.

(= (?) *V. populifolia* Greene Pitt. 3, 337.)

V. Stoneana x *triloba* Brainerd, Bull. Torr. Bot. Club. 39, 93.

Of the above hybrids, totalling not less than sixty, only two have been recorded from Canada.

These are *V. cucullata* x *septentrionalis* and *V. fimbriatula* x *septentrionalis*.

V. CUCULLATA x *SEPTENTRIONALIS*.

This hybrid was first described by Dr. Greene¹¹ as *V. melissaefolia* from specimens collected in 1902 by Mr. L. W. Watson on Prince Edward Island. Its hybrid nature was, however, later recognized by Dr. Brainerd, who also states that plants belonging to the same combination, have been collected by Dr. J. Fletcher at St. Stephen, N.B.¹²

¹¹ Pittonia, vol. 5, p. 103.

¹² Rhodora, vol. 6, p. 220.

In the Geological Survey herbarium of Ottawa there is a specimen collected by Mr. J. M. Macoun at "Billings' Bush near Ottawa, May 18th, 1898," which puzzled the collector. It is mounted as No. 18761 with two specimens labelled *V. septentrionalis* Greene. The collector, however, was in doubt whether it should be referred to *V. septentrionalis*, and therefore wrote on one side of the specimen "*V. cucullata*?" In other words, the collector was in doubt as to whether it should be considered a form of *V. cucullata* or whether it should be referred to *V. septentrionalis*. In some respects it shows the characters of one of these species, in others it comes close to the other one.

There is no doubt, however, that the specimen in question represents a true hybrid between the species mentioned. The authors have had the opportunity to revisit the locality and have observed and collected many specimens of the hybrid, growing with their parent species.

V. cucullata x *septentrionalis*, as it occurs in the vicinity of Ottawa, reminds one at a superficial glance, very much of *V. cucullata*. It forms dense and very vigorous bunches and develops an abundance of beautiful sky-blue flowers which, like those of *V. cucullata* are borne on pedicels much surpassing the leaves and which, therefore, are very conspicuous. The exposed position of the flowers is, however, not the only thing which makes them so conspicuous. They are, in addition to being numerous and of a very rich colour, surprisingly large, in fact much larger than the flowers of either *V. cucullata* or *V. septentrionalis*.

A closer examination of the specimens collected reveals the fact that as far as their morphological characters are concerned, they represent undoubted intermediates between *V. cucullata* and *V. septentrionalis*. It is true that their pedicels are much longer than those of *V. septentrionalis*, but on the other hand they are decidedly shorter than those of *V. cucullata* and though soft and weak, are not slender as is the case with the pedicels of *V. cucullata*. The herbage of the hybrid plants differs from that of the glabrous *V. cucullata* in being very sparsely and obscurely hirtellous-hairy, and by the very same character from *V. septentrionalis*, which is rather conspicuously hairy, especially on the petioles.

The characters of the sepals in the hybrid are also intermediate between those of the parent species. In *V. cucullata* the sepals are perfectly glabrous, i.e., are not at all ciliolated

along the margins, whereas the sepals of *V. septentrionalis* are strongly and very conspicuously ciliolated. In the hybrid the sepals have rather sparsely ciliolated margins.

The conclusive evidence showing beyond doubt that the plants are forms of neither *V. cucullata* nor *V. septentrionalis*, but hybrids between those species, is, however, furnished by the pollen. An examination of the same proves this without doubt. A large number of pollen grains are perfectly sterile, as a matter of fact not less than about 95 per cent, whereas pollen from specimens of *V. cucullata* and *V. septentrionalis*, collected with the hybrid, shows one hundred per cent perfect grains.

V. FIMBRIATULA X *SEPTENTRIONALIS* was collected at Charlottetown, P.E.I., by Mr. L. W. Watson.¹³ As specimens of this hybrid have not been seen by the authors of the present paper, it will not be discussed here.

In the spring of 1913 the authors made a joint excursion to Chats Falls, Ont., situated on the Ottawa River, and only about 20 miles from the Capital. Among other interesting finds was a violet hybrid which is of special interest not only because it has not been recorded before from America, but also because the species from which it had been formed belonged to a group in which hybrids, so far, have never been observed on the American continent. The hybrid in question is

V. CONSPERSA RCHB. X *ROSTRATA* PURSH.

The occurrence of this hybrid in the Ottawa district is furthermore of interest, because *V. rostrata* is a comparatively rare plant in these latitudes. As a matter of fact, its occurrence at Chats Falls was a very agreeable surprise to the authors as so far, it had been recorded only from three localities in the vicinity of Ottawa. The occurrence of the hybrid between *V. rostrata* and *V. conspersa* was, as a matter of fact, less surprising than the occurrence of *V. rostrata* itself. The two species grew mixed together and blossomed at the same time. Consequently as hybrids between allied species of violets are very readily formed—a fact that is most emphatically demonstrated by the list of hybrids, given on previous pages—the discovery of the combination *V. conspersa* x *rostrata* was really only a matter of diligent search, it being quite a natural consequence of the parent species growing together.

¹³ Brainerd, *Rhodora*, vol. 6, p. 217.

The most conspicuous difference between *V. conspersa* and *V. rostrata* is, as is well known, that the spur of the former is less than 8 mm. long and comparatively stout, whereas the spur of the latter species is 10-12 mm. long and slender. The hybrid found at Chats Falls is characterized by having a spur the size and shape of which is just intermediate between those of the parent species. All other morphological characters, which it is hardly necessary to describe in detail, are also intermediate between those of *V. conspersa* and *V. rostrata* making it quite certain that the plants referred to are natural products of a spontaneous cross-fertilization between the species in question. That this really is the fact, is furthermore proven beyond doubt by the condition of the pollen as developed in its petaliferous flowers. Ninety-five to one hundred per cent of the pollen grains are imperfectly developed, shrunk, deformed and empty. Consequently they are sexually impotent and incapable of fertilizing the ovules of either the hybrid itself or of the parent plants.

What has been written must be considered as only an introduction to a more complete and detailed study of the genus *Viola* but it is hoped that enough has been said to encourage local botanists to undertake similar work in this genus within easy walking distance of their homes.

AUGUST BIRD LIFE AT PLEASANT POINT, ONT.*

BY MELVILLE DALE.

During the past three summers it has been my privilege to spend part of the month of August at a little summer resort called Pleasant Point, situated on Sturgeon lake, some ten miles from Lindsay, and some seventy miles north-east of Toronto. The Lake is one of the Kawartha group and is part of the Trent Valley canal system. It is about fifteen miles long and from one to two miles wide. A dam at Bobcaygeon has raised the level of the lake to some extent, and formed a considerable area of "drowned land" at the mouth of the Scugog river. This marsh is composed of the usual growth of wild rice, bulrushes, pickerel weed, white and yellow pond lilies, etc., while many lagoons both large and small are found within its confines. In certain localities numerous stumps rise a foot or so above the water and form a favorite roosting place for the gulls, terns and herons.

*Read before the McIlwraith Ornithological Club of London.



Malte, M. O. and Macoun, James Melville. 1915. "Hybridization in the Genus Viola." *The Ottawa naturalist* 28(12), 161–168.

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