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First contribution to knowledge of the inheritance of the corolla colour in gloxinia (Sinningia speciosa)

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Genetica. — *First contribution to knowledge of the inheritance of the corolla colour in* gloxinia (Sinningia speciosa). Nota di GIAN CARLO VANDONI, presentata (*) dal Corrisp. C. BARIGOZZI.

RIASSUNTO. — Su progenie di piante autofecondate e di opportuni incroci è stata analizzata l'ereditarietà della colorazione viola, violetta e rossa della corolla, valutata anche con cromatografie su strato sottile. È stato riscontrato allelomorfismo tra questi fenotipi. La base ereditaria appare bifattoriale con geni indipendenti ed alleli dominanti e recessivi (segregazione 9 : 3 : 4).

INTRODUCTION

Sinningia, a genus belonging to the Brazilian flora, comprises over 20 species; some of them are ornamental and covered by the common denomination of Gloxinia. The best known species is *Sinningia speciosa*: the forms named Gloxinia by the flower growers are derived from it, probably through hybridization and selection.

The plant is herbaceous, pubescent, dwarf or characterized by short stems, projecting from a commonly tuberous rhizoma. The leaves are opposite, large, oval, and have a long stalk. The flowers, usually large, solitary or fasciculated at the leaf's axil, are uniformly coloured or dotted. The colour is white, red, pink, violet or blue-violet.

No bibliographical data regarding the genetics of this plant have been found; only the chromosome number has been studied (Sugiura, 1936 from Darlington and Wyllie, 1955; Clayberg, 1967).

For these reasons it seemed worthwile to submit the transmission of flower colour to Mendelian analysis in order to determine the genotype controlling the following colours: blue-violet, violet, red. White was not considered since it did not appear as a segregant in my experiments.

MATERIAL AND METHODS

The present investigation made use of a selection of commercial cultivars, grown according to the normal breeding technique: the genotypes of blue-violet, violet and red plants were analysed following self-pollinations obtained by common pollination techniques. In this paper discontinuous colorations of the corolla (dottings and variegations) are not considered; these phenotypes are now being investigated.

During the 1970-71 season (first experimental series) the following self-pollinations have been set up: blue-violet, violet, red. The first results are related to a total of 517 plants.

(*) Nella seduta del 14 aprile 1973.

The second experimental series (1971-72) permitted analysis of the offspring obtained through self-pollination in the first series and testing of the hypothesis formulated as a result of the first experimentation.

The definition of each phenotype was completed by a chromatographic analysis of each type of colour, i.e. blue-violet, violet, red and an additional variety of red, which will be mentioned later.

The chromatographs of the pigments extracted with 80 % ethanol, were obtained using a silicogel layer, the mobile phase being phenol saturated with water. Repeatability of the chromatographs of the same phenotype was fully satisfactory.

The chromosomes were counted in root tip cells, fixed in Carnoy and stained with Feulgen.

OBSERVATIONS

A) *Analysis of the Phenotype.*

BLUE-VIOLET: blue-violet is by definition the strongest of the three colours considered.

The chromatograph is characterized by: 2 azure spots (Rf 0,13 and 0,18 respectively), 1 yellow spot (Rf 0,32), 1 blue-violet spot (Rf 0,45) and 1 very pale blue-violet spot (Rf 0,58).

VIOLET: is lighter than blue-violet.

Chromatograph: 1 yellow spot (Rf 0,09), 1 azure spot (Rf 0,15), 1 blue spot (Rf 0,19), 2 yellow spots (Rf 0,22 and 0,31 respectively) and 1 violet spot (Rf 0,45).

RED: this phenotype exhibits some subjective variability but is never so light as to be pink, nor can it be misclassified as violet or blue-violet.

Chromatography: 1 azure spot (Rf 0,18), 1 red spot (Rf 0,38) 1 yellow spot (Rf 0,44) and 1 light red spot (Rf 0,52). In four offsprings a variety of intense red was noticed, already mentioned previously, provisionally named « Cardinal ».

All " Cardinal " flowers analysed revealed the same chromatograph which differs considerably from that of red.

Chromatograph: 1 azure spot less strong than in red (Rf 0,17), 1 yellow spot (Rf 0,27), 1 red spot (Rf 0,37), 1 yellow spot (Rf 0,45) and 1 light red spot (Rf 0,51).

B) *Analysis of the Genotype.*

The first data have shown that blue-violet can segregate violet and red, and that white never appeared. Therefore it was hypothesized that all three considered genotypes were controlled by two independent genes, the alleles of which behave as dominant-recessive. The segregation model proposed in conformity with the experimental results (see Table I c) was 9 blue-violet; 3 violet; 4 red, thus postulating a recessive espistasis.

As a consequence, the following genotypes can be assigned to blue-violet: AABB, AABb, AaBB, AaBb. A second consequence is that violet can be aaBB or aaBb, while red can be AAbb, Aabb, aabb.

Blue-violet × blue-violet, thus, can also segregate 3 blue-violet: 1 red (Table I a) and 3 blue-violet: 1 violet (Table I b).

TABLE I

Segregations of self-pollinations of blue-violet.

1 a) *Segregation: 3 blue-violet : 1 red.*

LINE	Blue-violet			Red			X^2 (d.f. = 1)	P
	obs.	expected	d	obs.	expected	d		
2	19	21.75	2.75	10	7.25	2.75	1.39	20–30
5	28	29.25	1.25	11	9.75	1.25	0.21	60–70
8	30	33.00	3.00	14	11.00	3.00	1.09	30
Total	77	84.00	7.00	35	28.00	7.00	2.33	10–20

1 b) *Segregation: 3 blue-violet : 1 violet.*

LINE	Blue-violet			Violet			X^2 (d.f. = 1)	P
	obs.	expected	d	obs.	expected	d		
97	16	15.00	1.00	4	5.00	1.00	0.26	50–70

1 c) *Segregation: 9 blue-violet : 3 violet : 4 red.*

LINE	Blue-violet			Violet			Red			X^2 (d.f. = 2)	P
	obs.	expec.	d	obs.	expec.	d	obs.	expec.	d		
98	7	—	—	2	—	—	3	—	—	—	—
170	8	—	—	2	—	—	2	—	—	—	—
Tatal	15	13.59	1.41	4	4.53	0.53	5	7.55	2.55	0.92	50–70

Violet can be either homozygous (when violet × violet gives no segregation) or heterozygous (when violet × violet segregates 3 violet: 1 red, see Table II).

TABLE II

Segregations of self-pollination of violet.

Segregation: 3 violet : 1 red.

LINE	Violet			Red			X^2 (d.f. = 1)	P
	obs.	expected	d	obs.	expected	d		
21	26	24.00	2.00	6	4.00	2.00	1.17	20–30
22	29	30.75	1.75	12	10.25	1.75	0.39	50–70
26	30	30.75	0.75	11	10.25	0.75	0.07	70–80
45	29	30.75	1.75	12	10.25	1.75	0.39	50–70
46	30	30.75	0.75	11	10.25	0.75	0.07	70–80
68	29	25.50	3.50	5	8.50	3.50	1.92	10–20
69	22	22.50	0.50	8	7.50	0.50	0.04	80–90
70	19	18.75	0.25	6	6.25	0.25	0.01	90–95
71	21	21.75	0.75	8	7.25	0.75	0.10	70–80
136	31	31.50	0.50	11	10.50	0.50	0.03	80–90
140	14	18.00	4.00	10	6.00	4.00	3.55	5–10
Total	280	285.00	5.00	100	95.00	5.00	0.34	50–70

Red × red is not expected to segregate. In fact pooled data from 9 indipendent self-pollinations of resulted in 334 plants all of the same colour.

The red variant "Cardinal" mentioned before came from two red plants, one aabb and the other Aabb or aabb. Provisionally, it seems possible to interpret this phenotype as controlled by some modifier of A and B loci.

To the segregations which conforms to the 9 : 3 : 4 model, two cases of blue-violet self-pollinations must be added. Pooling the data, the segregation is the following 4 blue-violet, 31 violet and 9 red. They are similar to each other and differ obviously from 9 : 3 : 4. For explaining them additional assumptions are required, like aneuploid conditions or other unknown chromosome situations.

C) *Analysis of the Chromosomes.*

The chromosome number found in the root tip cells is nearly 56. The chromosomes are very small and are not amenable for a more detailed analysis.

This counting agrees with that of Sogiura (1936), who interprets it as tetraploid. Clayberg (1967) reports 13 chromosomes in the gametophyte, hence the sporophyte should have $2n = 26$ chromosomes.

Discussion

1) *Segregation and chromosome number.*

All segregation data reported in this paper agree with the assumption that the genome of the Gloxinia in question is diploid. However, the data provided by other Authors do not agree as to the degree of ploidy of this species; thus 56 chromosomes should correspond to tetraploidy. The present data could be interpreted in three different ways:

a) the 56 chromosomes could reflect an amphidiploid costitution;

b) the material studied is not a perfect tetraploid, but the chromosomes involved in colour trasmission are present in pairs and not in quadruplets;

c) 56 is not a tetraploid but a diploid number.

The high chromosome number did not allow a more precise analysis, thus the question remains open.

2) *Genotypic determination of colour.*

The three main colours considered in the present paper examined not only by direct inspection, but also by means of chromatography, can be fairly thoroughly analysed.

I shall try therefore to draw some conclusions from the comparison of chromatographs and corolla colours. The presence of both dominant alleles A and B (blue-violet), irrespective of their dose, gives the richest chromatograph with the highest number of spots. Violet (presence of B) shows the loss of the light violet spot and the substitution of the blue-violet spot by a violet one. Red (absence of B) corresponds to one single azure spot, red spots instead of blue-violet and violet, and the appearance of yellow spots. Therefore B seems to be responsible for blue-violet and violet spots.

The blue-violet colour (both A and B present) shows a summation of A and B chromatographs, but yellow is stronger in violet than in blue-violet; thus a certain interaction is observable which cannot at this point be analysed further. The chromatographs of "Cardinal" differs from that of red by having only one yellow spot.

Conclusions

The conclusions reached so far are that red (the variant "Cardinal" has not been taken into account because it is difficult to recognize and has not yet been sufficiently analyzed) is a stable condition resulting from self-pollinations; both blue-violet and violet, also self-pollinated, can however, segregate. In fact, the available material (13 blue-violet lines) offers only

one case, which is probably a homozygote. All the 11 violet lines segregated for B/b.

To improve knowledge of the interesting characters of this species, the immediate aim seem to be the following:

1) to obtain homozygous lines for blue-violet and violet;

2) to obtain a better knowledge of the genotype of "Cardinal", which may be of some economical value;

3) the define the genotype of the white variant in connection with the genotype of the other colour variants;

4) to carry out genetical analysis of dottings and variegations. Furthermore, the genetical control of colour, shape and hairiness of the leaf and the phyllotaxis should also be investigated.

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