genese gänzlich verschwinden; dagegen scheint der Unterschied in der Chromosomengröße auf den verschiedenen Entwicklungsstufen der Pflanzen erhalten zu bleiben. Dies legt die Vermutung nahe, daß es sich bei den Unterschieden in der Chromosomengröße um erbliche Unterschiede im Bau der Chromosomen handelt. Untersuchungen, in denen versucht werden sollte, Anhaltspunkte darüber zu gewinnen, ob die verschiedene Größe der Chromosomen auf einem unterschiedlichen Polytaeniegrad beruhen, konnten leider noch nicht durchgeführt werden.

Zusammenfassung

Diploide Gigaspflanzen hatten im Vergleich zu nahe verwandten Formen ohne Gigascharakter teils vergrößerte Chromosomen, teils bestanden keinerlei Unterschiede in der Chromosomengröße. In einigen Fällen konnten keine sicheren Aussagen über Unterschiede in der Größe der Chromosomen gemacht werden.

Bei allen daraufhin untersuchten diploiden Gigasformen beruht die Vergrößerung der Organe nicht allein auf einer Zunahme des Zellvolumens, sondern in einer im einzelnen sehr stark verschiedenen Vermehrung der Zahl der Zellen. Im Extrem kann der Gigaswuchs ausschließlich auf die Steigerung der Zellenzahl zurückgehen.

Diploide Gigaspflanzen können im Vergleich mit verwandten normalwüchsigen Pflanzen in bestimmten Entwicklungsstadien bzw. Organen vergrößerte Zellen besitzen, in anderen Organen dagegen können derartige Unterschiede fehlen. Hinsichtlich der Chromosomengröße konnte ein entsprechendes Verhalten nicht beobachtet werden.

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The genetics of diploid × tetraploid and reciprocal cyclamen crosses

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1. Introduction

In 1941 KAPPERT (1) discussed the breeding of *Cyclamen persicum* in an admirably clever way. He pointed to the fact that our coloured flowering varieties are autotetraploids with 96 chromosomes and he demonstrated in detail the difficulties in breeding-work on account of this fact.

A principal solution of these difficulties would be the reduction of the number of chromosomes to the diploid condition and several ways of reaching this aim were indicated. One of them would be the crossing of diploids (white) and tetraploids (coloured) in the expectation that the F_1 is triploid, while in its offspring, either after selfing or backcrossing, diploids (coloured) arise. KAPPERT apparently succeeded in obtaining diploids from tetraploid × diploid, followed by backcrossing the triploid F_1 with diploid (private correspondence dated 7th January 1952).

However, a disagreeable complication may occur in applying this method, namely the relatively high frequency of tetraploid F_1's. KAPPERT, in his above cited correspondence, informs me that in one year out of 20 F_1-plants 14 were tetraploid.

We have been able to confirm this tetraploid condition of several F_1's from diploid × tetraploid and reciprocal crosses and also to demonstrate the autotetraploid character by genetical segregation. The cytological part of the work was started by Dr Iz. DE HAAN (3, p. 616, and unpublished) and is being continued by Ir R. A. H. LEGRO. Details will be published later. The present contribution deals with the purely genetical phase of the problem.

2. The genetics of flower colour in diploids

For a good understanding of the following, the genetics of the colours „white with eye", „purple" and „white" in diploids should be summarized. It was demonstrated in an earlier paper (3), extended in (2), that two genes, W and S, influence these characteristics according to the following genotypes:

$$\begin{array}{rl} \left.\begin{array}{rl}\text{WWSS:} & \text{white with eye}\\ \text{WWss:} & \text{purple}\end{array}\right\} & \text{coloured}\\ \left.\begin{array}{r}\text{wwSS:}\\ \text{wwss:}\end{array}\right\} & \text{white}\end{array}$$

In the existing varieties frequently heterozygotes, like WWSs, WwSS or WwSs — all phaenotypically white with eye — or like Wwss-purple, were found. This also happened in part of the parents from the crosses to be discussed in 3.

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* Herrn Prof. H. KAPPERT zum 65. Geburtstag gewidmet

3. The diploid × tetraploid and reciprocal crosses

1. Material. — For the moment 5 crosses 2n×4n and 2 crosses 4n × 2n have been studied. One cross 2n × 4n has yielded 2 triploid F_1-plants which were very highly sterile and which have not given any offspring. In all other cases both F_1's and F_2's and one F_3 — the only one studied thusfar — were completely tetraploid (Legro). Of these 6 „tetraploid" crosses 3 could be used for a genetical analysis, since genes W and/or S as described sub 2 were segregating.

2. Segregations for gene W. — Two diploid purple × tetraploid white and one reciprocal cross gave coloured F_1's and F_2-segregations as follows:

98	coloured:	5	white
115	,,	1	,,
126	,,	6	,,
339	,,	12	,,
(341)	,,	(10)	,,

expected according to 35:1.

This result suggests that the cross has been: WW × wwww, and the F_1's: WWww, so that the gametes of the diploid parents have been unreduced or doubled after reduction. This F_1 WWww segregates in F_2 according to a 35:1 ratio.

Out of the 4 phaenotypically coloured F_2-genotypes WWWW is constant, WWWw does not visibly segregate, WWww segregates as the F_1 in 35:1, while Wwww segregates as 3:1. Thusfar the F_3 data are limited and comprise the progenies of 7 coloured F_2-plants. Out of these:

1 was constant with a number of 110 plants.

2 segregated as 45 coloured: 10 white
expected 3:1 (41) : (14)

4 did not visibly segregate, but the total number of plants was only 32, so that this material is without any value.

It is interesting that rather definitely 3:1 segregations occurred. As a whole these F_3-data are too incomplete to make direct evidence for the autotetraploid character of the plants, but they can be considered as a partial confirmation of the F_2, while they certainly do not contradict the expectation.

3. Segregations for gene S. — In one diploid purple × tetraploid white cross F_1-plants were found with either white with eye or purple flowers. The progeny of one white with eye F_1-plant in F_2 consisted of:

28 white with eye: 7 purple
expected according to 3:1 (26) : (9)

These observations might suggest that the cross has been ss × Ssss, the F_1 either Ssss or ssss, so that again the gametes of the diploid parent have been unreduced or doubled after reduction. Ssss segregates 3:1 in F_2, namely 1 SSss : 2 Ssss : 1 ssss. This assumption has been confirmed by F_3 observations. The expectation is that SSss-F_2's will segregate 35:1, while Ssss-F_2's segregate 3:1. In reality 2 white with eye F_2's segregated as:

49 white with eye: 4 purple
expected according to 35:1 (51.5) (1.5)

while 2 other white with eye F_2's segregated as:

23 white with eye: 8 purple
expected according to 3:1 (23) : (8)

Hence both 35:1 and 3:1 have occurred.

4. Conclusion

Some of the above observations are direct evidence for an autotetraploid segregation in F_2 and F_3 of diploid × tetraploid and reciprocal crosses, while other observations are insufficient in themselves, but form a partial confirmation of the hypothesis of autotetraploidy. Although further research is under way, the present experimental material already makes it rather certain that once a tetraploid F_1 has been obtained, it remains tetraploid in further generations and behaves as an autotetraploid. The difficulties in breeding-work, arising from this situation, need not be discussed in detail after Kappert's paper, referred to in the introduction.

The attention should be drawn to the remarkable fact that both diploid × tetraploid and tetraploid × diploid crosses may succeed, while the autotetraploidy in F_1 and further generations holds true in both cases. In the diploid × tetraploid cross the egg cell and in the tetraploid × diploid cross the sperm cell must have been unreduced or doubled after reduction. The material at hand does not allow to decide between non-reduction and doubling.

5. Zusammenfassung

Bis heute wurden bei Cyclamen 5 Kreuzungen diploid × tetraploid und 2 Kreuzungen tetraploid × diploid untersucht. Eine lieferte nur 2 weitgehend sterile triploide F_1-Pflanzen. In allen anderen Fällen waren F_1, F_2 und — soweit untersucht — F_3 vollständig tetraploid.

In 3 Kreuzungen konnte die Blumenfarbe analysiert werden. Es stellte sich heraus, daß die F_2- und F_3-Spaltungen einem autotetraploiden Schema entsprechen. Hieraus geht hervor, daß bei den Kreuzungen diploid × tetraploid die Eizelle unreduziert oder verdoppelt vor der Befruchtung ist, während bei den Kreuzungen tetraploid × diploid der generative Kern unreduziert oder verdoppelt vor der Befruchtung sein muß.

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