ON THE TRIPLOID JAPANESE LILY OF THE VALLEY FOUND IN THE WILD OF HOKKAIDO

BY

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(With 5 text-figures)

The lily of the valley, *Convallaria majaris*, is one of the most familiar and beloved wild flowers in the northern countries. There have been some cytological studies on it, namely of STRASBURGER (1888), WIEGAND (1899, 1900) and SAUER (1910). In 1924, the present writer made some preparations of the anthers of the Japanese lily of the valley, *Convallaria majaris* var. *japonica*, which was cultivated in the Botanical Garden at Sapporo, applying the ordinary paraffin method fixed with the Flemming-Bonn solution. At that time, however, he could not determine the chromosome number, on account of the very abnormal shape of the chromosomes and irregular mode of the reduction division in the pollen mother cells. So it had been assumed that such abnormal figures might be caused by inadequate fixing, till in 1928 success was attained in ascertaining the triploid nature of that plant applying the iron-acetocarmine method. Among the materials from the Botanical Garden two caryological types of *Convallaria majaris* var. *japonica* were found, one was diploid and another triploid. The writer inquired about that triploid plant of Mr. ISHIDA, the garden inspector, who had collected that plant at Tsukisappu, a suburb of Sapporo, several years before. He answered that the plant had bloomed double flowers when it was found in the field, but this character disappeared and the flower became single after it was transplanted to the Botanical Garden. According to the writer's investigation, however, several differences of outer and inner characters between the normal diploid plant and the triploid can be recognized even now.

The diploid *Convallaria majaris* var. *japonica* has eighteen bivalents in the heterotypic division of the pollen mother cell (fig. 1)[1]. The behaviour of the

1) The bivalent chromosome number 18 in the heterotypic division of the pollen mother cell of the European strain of *Convallaria majaris* was also determ'ned (fig. 2). This number agrees wiih that reported by WIEGAND (1899, 1900), but differs from that of STRASBURGER (1888) and SAUER (1910).

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reduction division is very regular and produces normal pollen grains and few abortive ones.

In the triploid plant, however, some irregularities of the arrangement and segregation of the chromosomes in the reduction division of the pollen mother

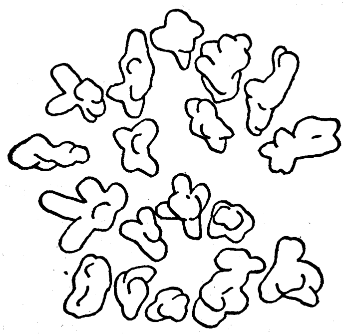

Fig. 1

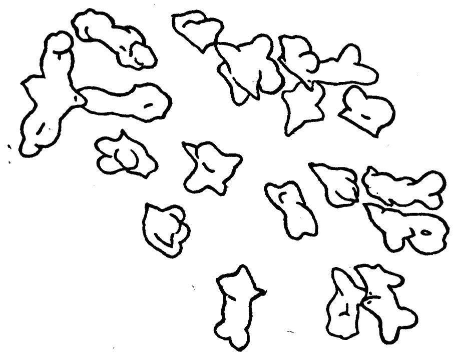

Fig. 2

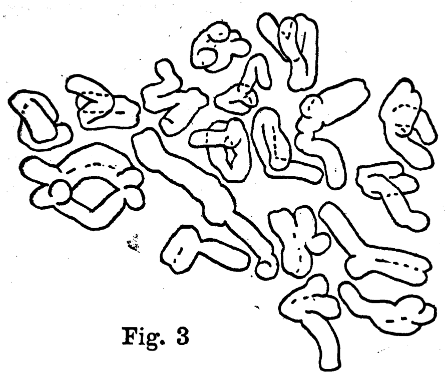

Fig. 3

Figs. 1–3 Metaphase of the heterotypic nuclear division in P.M.C.s. 1) *C. majaris* var. *japonica* diploid type, showing 18 bivalent chromosomes. 2) *C. majaris*, showing 18 bivalents. 3) *C. majaris* var. *japanica* triploid type, showing 18 trivalents.

cells were observed. There are an indefinite number of trivalents, bivalents and univalents mingled with each other in the heterotypic nuclear division and in a few cases apparently eighteen trivalents were observed (fig. 3). The univalents go to the poles at random unsplit in the heterotypic division, and they split in the homœotypic division. The size of the pollen grain is larger than that of the diploid and sometimes we can find irregular shaped or giant or many abortive ones.

The autotriploid plants generally show a tendency for the volume of the cells, the size of the organs and the whole body to increase corresponding to the increase of the chromatin quantity compared with the normal diploid plant (fig. 4, 5). Comparing the cubic values of the length of stoma of the diploid and triploid plants with each other, an approximate ratio 1 : 1.5 was determined which shows the increase of the volume of the triploid cell corresponding to the chromatin quantity (table 1). The flower of the triploid plant is not only larger than the diploid, but also the number of the anthers and petals is increased; 6–9, generally 8, in the triploid, while they ordinarily count 6 in the diploid (fig. 5).

Fig. 4

It was noticed by several authors that the size of the leaves of the autotriploid plants is larger than the diploid. The writer's attention was paid to the form of the leaves and he found that the ratio of the breath to the length of the laminæ of the leaves of the triploid *Convallaria* is distinctly larger than that of the diploid (table 1). Under some growing conditions the triploid plants grow sometimes smaller than the normal diploid. However, the ratio of the breadth to the length of the lamina is never disturbed. Therefore, it serves as one of the most useful characters for the distinct recognition of the triploid plants. In fact, paying

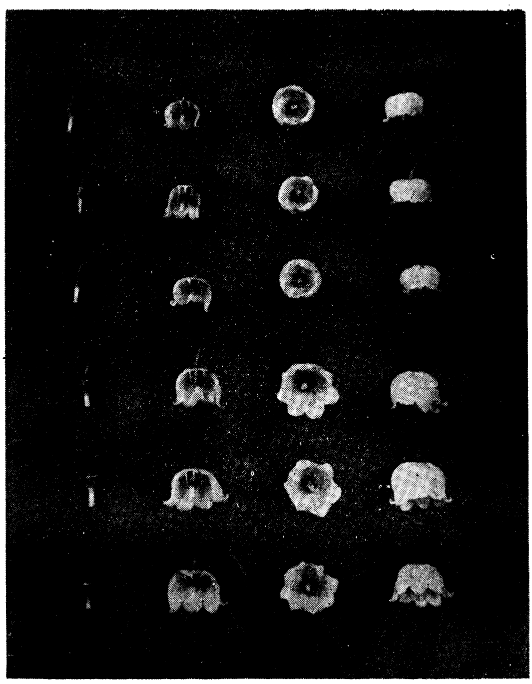

Fig 5.

Figs. 4, 5 *C. majaris* var. *japonica*. 4) aerial portion; left three plants are diploid type and the right three triploid type. 5) Flower organs; upper three rows are normal diploid type and the lower three triploid type.

attention to this characteristic point the writer found some wild triploid plants ot *Convallaria majaris* var. *japonica* and *Paris hexaphylla*. But to what extent such a method can be applied in the case of other plants is a problem to be solved in future.

It is a generally known fact that the lily of the valley grown in Abira, Hayakita, Shimamatsu, Nishitappu and Yunokawa in Hokkaido are larger than those in some other places, and it is believed that the soil or climate conditions of those districts are fit for the growth of that plant. According to the writer's opinion, the giant nature is chiefly caused by the triploid nature of the plant itself. About the origin of such triploid *Convallaria*, the following explanation seems to be probable: The reduction division of the pollen mother cells of *Convallaria majaris* var. *japonica* takes place in early May, and the atmospheric temperature of Hokkaido at that time varies to a relatively high degree, and sometimes the difference between the day and night time becomes very large. So the chance is not so small to produce the diploid pollen grain after the irregular reduction division caused by the abnormal temperature. When a normal haploid egg was fertilized with a diploid pollen, a triploid embryo may be produced. One more noteworthy fact is that the triploid *Convallraia* were found in the open field of volcanic ash soil near the active volcano, Mt. Tarumai, while in the field of ordinary soil far from any active volcano, for instance in Garugawa, the plants are diploid. The above mentioned fact seems to show that there might be some relation between the active volcano and the occurrence of the triploid plants.

Summary

1) The chromosome numbers of *Canvallaria majaris* and *C. majaris* var. *japonica* were determined. both $n=18_{II}$ in P.M.C.

2) There are wild *C. majaris* var. *japonica*, which are larger and more vigorous than the normal diploid plants. They were determined to be triploid plants.

3) The ratio of the breadth to length of laminæ of the triploid *Convallaria* is larger than that of the normal diploid. This is one of the most useful characters for the distinct recogniton of the triploid plants.

Table 1 Comparison of some morphological characters of diploid and triploid types of *Convallaria majaris* var. *japonica*.

			C. majaris	*C. majaris* var. *japonica* (diploid type)	*C. majaris* var. *japonica* (triploid type)	*C. majaris* var. *japonica* (collected at Abira)	*C. majaris* var. *japonica* (Collected at Garugawa)
number of chromosomes in P. M. C.			18_{II}	18_{II}	18_{III}	18_{III}	18_{II}
Stoma	Mean[1] (μ)			52.905±0.055	59.693±0.043	50.599±0.116	
	Standard (μ), deviation			1.317	1.048	1.976	
	Cubic ratio of mean			1.000	1.458	1.640	
Lamina	Breadth	Mean (cm)	4.599±0.0382	6.831±0.c535	10.695±0.0593	8.633±0.c638	5.920±0.1032
		Standard deviatioa (cm)	0.651	0.849	1.010	1.320	1.082
	Length	Mean (cm)	15.280±0.117	15.394±0.08c5	18.682±0.131	15.995±0.111	13.430±c.2087
		Standard deviation (cm)	1.953	1.384	2.237	2.403	2.188
	Ratio	Mean (cm)	0.309±0.0024	0.444±0.0018	0.5723±0.c033	0.5495±0.0025	0.4407±0.c082
		Standard deviation (cm)	0.0410	0.0427	0.0562	0.0536	0.0371
	Correla-tion	Coefficient of correlation	0 6347±0 9351	0.7449±0.0185	0.7959±0.1198	0.7928±0.0171	0.51303±0.0696
Number of anther			6	6	(6-9) 8	(6-9) 8	6
Number of petal			6	6	(6-9) 8	(6-9) 8	6

1) The length of the stoma was msasured in distilled water.