CONVALLARIA MAJALIS (LILY OF THE VALLEY) IMPROVED AS ORNAMENTAL PLANT AFTER 35 YEARS OF BREEDING WORK

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Abstract

In 1951 when first crosses were made the mean number of flowers at a stalk was 10.5 in the normal commercial cultivar with relatively big flowers and varied from 6.9 up to 12.1 in the entries of wild material with very small flowers collected at different German localities where Convallaria majalis is indigenous. After 3 generations each of about 10 years mean values of up to 18 flowers per stalk in combination with a good single flower size and shape could be achieved in the best selections. However, the best gains in number of flowers per stalk could not yet be combined with the very important character of optimal yield of flower-buds i.e. the proportion harvested from the total of leaf-buds planted two years ago. This ratio could be improved from 65 to 95 % by selection, but so far only in those new introductions which produce about 13 flowers per stalk on an average, exceeding the old cultivar in this combination of main character values by far.

1. Introduction

In 1951 Professor Richard Maatsch emphasized that Convallaria majalis, the lily of the valley, should be improved by breeding in order to stop the decline of its commercial importance which was formerly high as an article of exportation for Germany and which was going to vanish because of competition with other cut-flowers, in particular the new varieties of Freesia. To encounter the problem, an increase of the number of flowers/stalk for improving the image of the cut-flower was regarded as necessary in the first line. As a breeding method, cross-breeding was chosen, though it appeared to be risky. Since all German proveniances of cultivated Convallaria had proved to belong to one cultivar, represented by one clone which had always been propagated vegetatively, lots of chromosomal mutations had accumulated, manifested by the formation of "bridges" and "laggards" in nearly every dividing PMC. These abberations were expected as leading to abortive gametes and loss of genetic material at the moment of seed propagation, which had never been tried before, sofar as we knew. To have another chance, we began induction of polyploidy successfully as a second breeding method (R. Reimann-Philipp, 1955) but we stopped the project when we found the variety 'Fortin' to have arisen from natural polyploidization.

2. Material and Methods

As there was no variation within German cultivated Convallaria with respect to "number of flowers/stalk" (the mean value

over all known as 10.5±0.18 in 1951), material from stands of wild C o n v a l l a r i a was collected from different regions of Germany, and from botanical and private gardens, where C o n v a l l a r i a samples taken from indigenous localities had been naturalized. With respect to "number of flowers/stalk" these entries which all had rather small flowers varied from 6.9 to 12.1. From crosses between the cultivated C o n v a l l a r i a and 13 different wild types carried out in a greenhouse mainly in April and May 1952 seeds harvested were sown in pots in late autumn 1952 and germinated in early spring 1954 in-doors, the pots so long having been stored out-doors. The seedlings showed their first flower not before 1960, and also a period of 8 to 10 years elapsed between sowing and first flower of a seedling in the 2nd and 3rd generation respectively. However, no precise crosses were made neither in F_1 to produce the F_2 nor in F_2 for F_3, but the best seedlings having been tested for at least 2 years were placed together in pots in an isolated group and hand-pollinated abundantly. In F_1 and F_2 seedlings were cultivated up to the first flower in the open field, spaced 1 by 1 m., harvested and separated into flower- and leaf-buds, the flower-buds being potted for forcing or crossing in case of promising quality. In F_3, seedling clones were kept in pots, later in containers, so avoiding contamination by weeds and intermingling.

In correspondance with our professional engagemant the work on the breeding material was done and was supported at the following institutions respectively:

- 1951-54 Institut for Research on Plant Genetics and Breeding, Technical University of Berlin (Dir. Prof. Dr. Dr. Dr. Hans Kappert);
- 1955-65 Institut for Applied Genetics, Technical University of Hannover (Dir. Prof. Dr. Dr. Hermann Kuckuck);
- 1966-73 Sengana GmbH, Hamburg-Volksdorf (Prof. Dr. Dr. Reinhold v. Sengbusch);
- 1974-1986 Federal Research Centre for Horticultural Plant Breeding, Ahrensburg (Dir. Prof. Dr. Rainer Reimann-Philipp).

3. Results

3.1. First generation

In none of the seedlings of F_1 the combination desired of the characters "high number of flowers/stalk" and "well-shaped, great single flower" appeared to be realized satisfactorily. However, several seedlings with at least 12 flowers/stalk at an average and single flower sizes surpassing those of the wild types could be selected to start the F_2 with.

3.2. Second generation

From 1969 on, seedlings of the F_2 came to flower and among these there were several of outstanding quality, reaching a mean value of 16 flowers/stalk (figure 1). Confirmation after tests and trials in the open and under forcing were not achieved before 1973, when the five best seedling clones were released for propagation. Then it became obvious that besides number and size of single flowers another demand had to be matched: productivity. Particularly a high

percentage of flower-buds (or "pips", as they are called in the USA), preferably near 100 %, harvested after a 2 years' period of cultivation after planting of the leaf-buds, is essential. With respect to this requirement only the seedling clone XII-25 proved to be satisfactory, and though its mean value for number of flowers/ stalk was not higher than 15.32 ± 0.34, exceeded in this combination the old cultivar by far.

Another 13 years elapsed before intensive vegetative propagation - yielding only the normal rate of 4/3 of the leaf-buds after each 2 years' cultivation period, "pips" not included - produced as much material as to allow its release into the market.

Since not only breeding of the "lily of the valley" was very time-consuming, but this counts also for vegetative propagation of the breeding products, a good method for in vitro-propagation seemed to be very desirable. At the Federal Research Centre for Horticultural Plant Breeding, this was tried by Preil et al. (1979) for several years. Though it was shown that flower-buds could be stimulated in vitro to produce callus, shoots and roots, the productivity of the method was unsatisfactory. To some extent, this disadvantage might in so far be profitable as "breeders rights" must not necessarily be protected; for because of the slow propagation progress - even in vitro - any illegal reproduction would operate with a rather long delay.

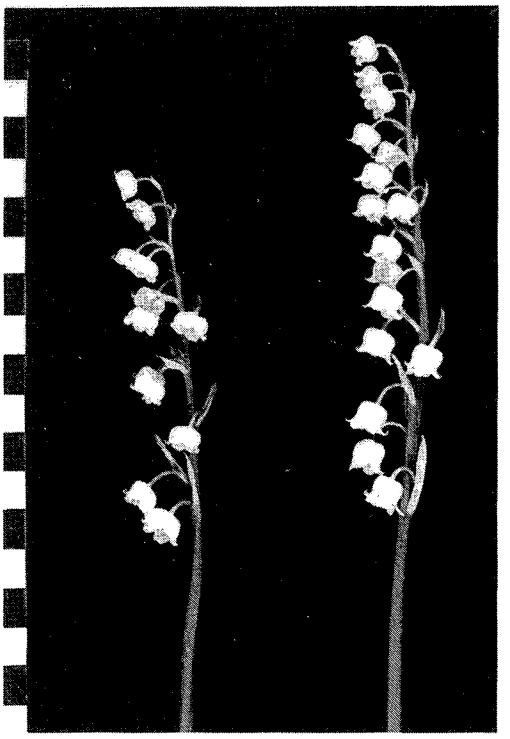

Figure 1 - Representative cut flowers of the standard variety (left) and the F_2-seedling XIII 31 (right; scale remarks read 1 cm)

3.3. Third generation

Based on the good results of the 2nd generation a 3rd generation was produced the first seedlings of which began to bloom in 1984 and so could already be evaluated in 3 successive years (figure 2). So far none of the seedlings surpassed the best ones of the 2nd generation with respect to "number of flowers/stalk". However, they represented only a small percentage of the total of the seedlings, which started with flowers in 1985 or 86 and are exspected to bloom in their majority in the next years. Now-a-days great interest is taken also in the selection of clones with special suitability for pot plant cultivation.

At the end of our breeding work, an investigation on chromosomal aberrations in dividing pollen mother cells of seedlings of the 3rd generation was carried out in early spring 1986. According to our expectation, "bridges" (indicating chromosomes with 2 centromeres) or "laggards" were found only very rarely showing that after 3 sexual reproductions the great majority of sublethal gametes had been eliminated.

1. Concluding remarks

Though propagation at all times was vegetative, and a somatic accumulation of chromosomal mutations was the consequence of it, which necessarily caused a break-down of genetic stability at the moment of sexual reproduction, improvement of essential characters by cross breeding was possible in C o n v a l l a r i a in the second generation already, however, every generation taking about 10 years.

References

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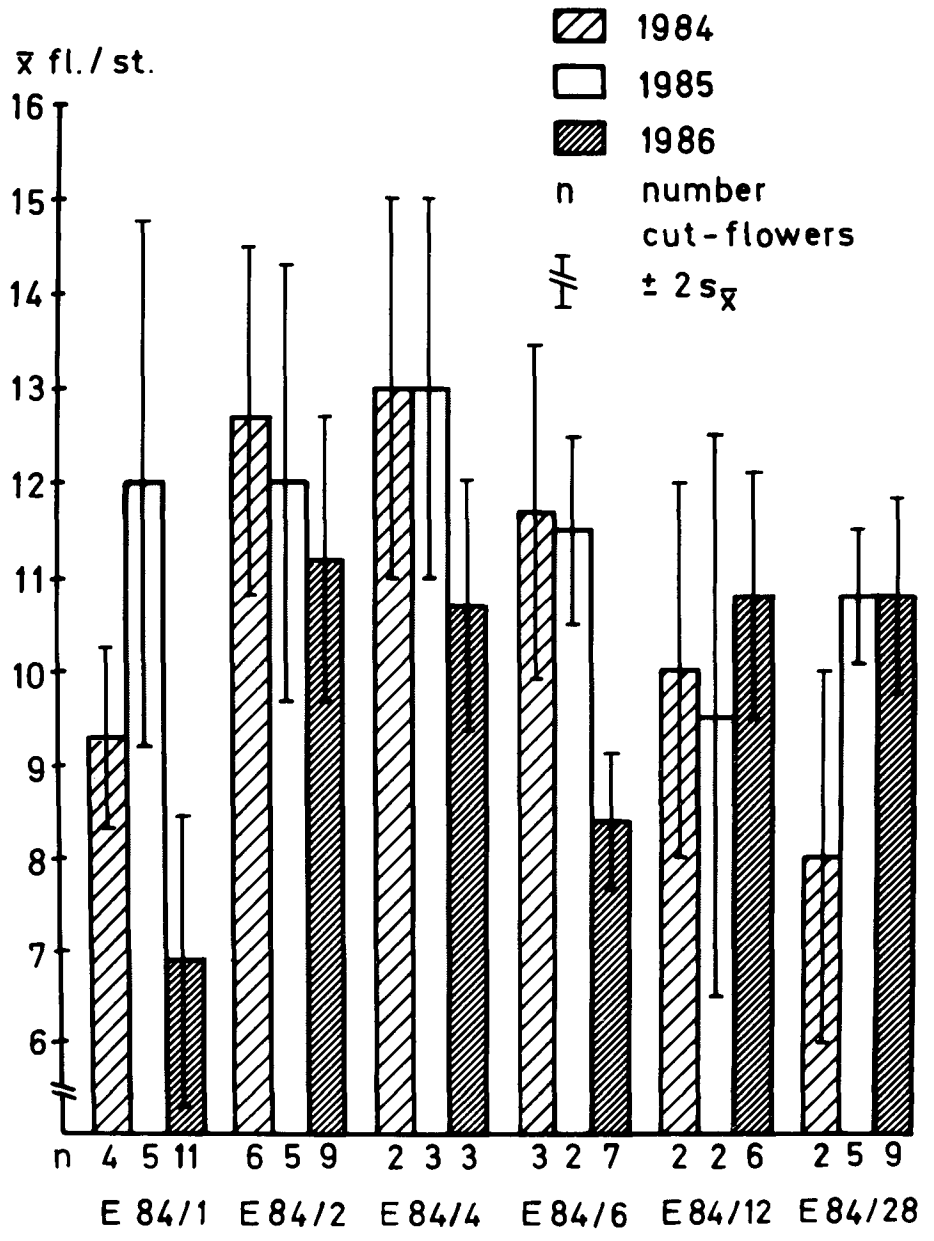

Figure 2 - Variation in "number of flowers/stem" in the first three flushes of some F_3 seedlings