OBSERVATIONS ON RED-FLOWERING DELPHINIUM UNIVERSITY HYBRIDS

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Abstract

Observations were carried out on 11 generations of red-flowering Delphinium University Hybrids to determine plant variation and to establish the rate of progress. It proved that plant height varied considerably within each generation, but the average height did not change very much through the years (total average height 95 cm). Spike length improved remarkably, the average being round 60 cm in the past two years. The average number of flowers per spike tripled and the average flower diameter went up from 4.5 to 5.7 cm, an increase of 27%. At present semi-doubleness is almost 100% and the colour range covers most basic colours, tints and shades in pink, red and carmine. The average conformation improved significantly but since 80 - 90% of each progeny still has to be discarded for one or another shortcoming, the material has not yet reached the final stage of development.

Introduction

In 1962 I reported at the XVI Int. Hort. Congress about the origin of the red-flowering Delphinium University Hybrids, as a result of crossing the experimentally obtained tetraploid species hybrid D.nudicaule x cardinale with the tetraploid D.elatum 'Black & White'.

At that time only 5 generations had been grown. Undesired characteristics of the wild species hybrid parent still dominated and a great variation was observed in plant type, spike and flower formation, perenniality, fertility and, in particular, in pink and red flower colours.

By selfing and by crossing plants with comparatively outstanding features, the average quality of the successive progenies had become unmistakably better. But how great the progress actually was and to what characters it applied was not known precisely since in the early program the changes had not been quantified. Besides, it was noticed that promoting an advancement in one detail sometimes led to an unexpected deterioration of another. How great this undesirable development was and how to minimize it or, in other words, how to prevent a casual progress and ensure a more gradual all-round improvement, was an open question.

As a first step in tackling the problems we started, in 1962, to count the numbers of flowers per spike, to measure the flower diameter and to determine the flower colour. This analysis was carried out with all plants of a progeny and the first results justified continuation and indeed the extension of the determinations. Beginning in 1965, with the eighth generation, data were collected concerning plant height, spike length, number of flowers per spike, flower size, flower character (four gradations from single to double), flower colour and date of flowering. So far a total of 9 327 plants, covering 11 generations, have been subject of these observations and the results are briefly discussed in the following.

Results

1. Plant height

The yearly measurements demonstrated, first, that plant height varies extensively within each generation, ranging from 40 cm to almost 2 m. This variation, still present after 18 generations, is obviously a long-established consequence of genetical differences between the originally used parental species and of the heterozygosity in the cultivated garden form used as the male parent.

Second, as Fig 1 shows, the average plant height of the consecutive generations also fluctuates. This phenomenon has not only a genetic cause, but reflects in addition a phenotype variation in response to annually different environmental conditions, such as light, temperature and soil structure (the plants were grown in pots in a cold, uncontrolled greenhouse). In 1968 and 1971 there were problems with chemically polluted sowing compost and potting mixture, respectively, and the responses of retarded growth and smaller plants are clearly visible as declines in the years concerned.

The figures do not allow very firm conclusions except that the average plant height did not change significantly through the years. It fluctuated around the total average of about 95 cm. A more purposeful use of very tall segregates may increase this figure in due time to approximately 125 cm, which is to my opinion a preferable height.

2. Spike and flower characters

The garden delphinium is characterised by its spike as no other borderplant is. No wonder that spike length, density and shape always command our utmost attention. The parental wild species D.nudicaule and D.cardinale produce anything but good spikes. The former makes tiny clusters of ten or twelve flowers and the latter has long and widely-spaced spikes. Consequently the use of their hybrid as a cross-partner brought in the genes for these (and other!) undesirable features. Their elimination is certainly not to be achieved in one day. It means that we have to build up the spike in our hybrid material, step by step, by making cross combinations aimed at an accumulation of the desired genes responsible for an elatum-type spike.

Thus far our efforts to improve spike quality have not been without success. As figure 1 shows, the average spike length increased from 34.6 cm in 1964 to 64.1 cm in 1974; a rise of 85 per cent. As, in the same period plant height has hardly increased at all, it means that the average plant has become much better proportioned; the spike length accounting for two-fifths (thirty-nine per cent) of the plant length at the beginning of our observations, extended to three-fifths (61 per cent) of the average height in 1974. Information about progress on this point was also obtained when we applied the requirement that a plant should form a spike half of its height, the minimum being 50 cm long. No less than 71.2 per cent of the plants of the 1974 generation and 73.1 per cent in 1975 reached this standard, whereas only 2.9 per cent did so in 1965.

The quality of a spike is not solely determined by its length. Equally important are its furnishment, its condition, the presence or absence of too many or sloppy laterals, bends in the stem or fasciations. To be well-furnished the spike must not show gaps nor be too open or too dense, a condition which depends on the number of florets, flower size, length and implantation angle of the pedicels, the way of their setting, etc. Quite apart from the question of what really is too open or too dense, it is impossible to have standards by which one can select and set up a crossing programme covering all of these items. Furthermore tastes differ.

Although it is not our task to create red-flowered delphiniums which fulfil every requirement, it was clear from the beginning that within the material the number of florets per spike had to be much increased. Previous test counts in 1962 indicated that the average number of flowers per spike was 23, rising to 28 in 1964. In 1965 it decreased to 20 but eversince we have been able to increase the average number, reaching 59.5 in 1975. However, when projected in a graph, as in figure 2, the yearly progress is not characterised by a regularly rising line, but by an erratic one, suggesting three steps forwards and one or two backwards; thus well illustrating the laborious way we have to go. We certainly have not achieved the quality of the modern blues in this respect but the improvement is obvious and is definitely continuing.

This also applies to the average flower diameter. The graph in figure 3 is also irregular rising and it shows distinctly the effect of the previously-mentioned culture problems of 1971. Nevertheless, the average flower diameter went up to 5.7 cm in 1975, which means an increase of approximately 1 mm per annum. At first sight this is not very impressive, but when we consider a flower diameter of 5 cm as an acceptable standard at present, the figures give a much better impression of progress; only 33.0 per cent of the 1965 progeny achieved this standard whereas 91.9 per cent of the 1975 generation did so. That is nearly three times as many. In 1965 only two plants out of 627 had flowers up to 7 cm across, while in 1974 sixty plants out of 726 produced flowers of 7-8 cm diameter. It means that a well-sized floret is achieved and also that the potential for a larger flower size is certainly present.

Ever since the break-through in 1958, realised by three plants which combined a red colour and the desired but recessive semi-double flower type, we have paid great attention to extending the number of semi-double flowered plants and to getting rid of the dominant characteristic for singleness. Today the stage of one hundred per cent semi-doubleness is almost attained and there is no need to bother any further about this detail.

What is really giving problems are other flower characteristics. A great proportion of the plants still bear flowers showing irregularities or malformations in one way or another. The phenomenon of so-called inner-spurs is the biggest malefactor. Due to differences in spur formation in the original cross parents, the nectar-producing spur attached to the "bee" does not fit or grow properly into the outer spur formed by the upper sepal. Consequently it lays inside the pip and in the worst cases it is split into open halves. The effect is an untidy flower form, by no means adding to the grace of the spike. This genetically-based occurence, as well as other unacceptable aberrations, leads us to discard a lot of plants every year.

In the early sixties, with the increasing diversity in pink and red flower colours, it became clear that descriptions such as pale, light or dark red were by no means sufficient to define the various gradations. Although it was experienced that pink and red are recessive colours, we had no idea about the mutual heredity of the many tints and shades and, in particular, how to maintain the attractive bright colours. Besides, we were interested to know what part of the spectrum was actually covered.

By comparison with the Hort. Colour Chart we found the greatest range in the 1964 generation. No fewer than 21 basic colours and 89 colour dilutions could be determined, spread over 15 full hues and 32 different tints, shades, and greyed hues. In the following generations additional colours appeared, such as the basic colours poppy red, scarlet, blood red, and orient red. But in spite of the continued great variation, true orange has not yet occured. Peach, carrot red, and the first dilutions of vermilion and mandarin red were the nearest so far.

The annual colour determinations supplied us with other important information: there exists a connection between flower colour and plant form. Although there are exceptions to the rule, plants with a more bluish red colour like carmine and claret rose have a better and more elatum-like form than those with a colour on the orange-red side of the spectrum. This is very likely due to a genetical linkage. Practically, it means that if the yearly selection of seed and pollen parents is too much based on the robust form of plants, we would end up with the loss of the bright red colours, which would be a great pity indeed!

It is of course impossible to cope with a hundred or so different tints and shades, therefore in practice we classify them into six categories; vermilion, rose, scarlet, medium red, deep brilliant red and carmine red. Pollinations are preferably made within the distinct categories, to come at least to some trueness in colour.

A controversial point is the question of laterals. Controversial indeed as so many visitors, growers among them, prefer a lot of long laterals to a few short ones, arguing that such provide a conspicuous patch of colour in the garden when the spike is finished and that laterals are useful for flower arrangements, etc. Notwithstanding these arguments, others favour a few short laterals and this is a preference to which I subscribe.

In general D. University Hybrids produce too many laterals. Often they are widely spread and located in a whorl just under the spike. In such instances the plants look like untidy Christmas trees and too many of each generation, although often highly qualified in other respects, have to be discarded for this shortcoming.

3. Form and reproduction

Throughout the years and explicit improvement in the average form of the plants has been noticed. In particular, the stems have become much firmer. They are, in many cases, similar to those of elatum cultivars and so is the foliage.

Form, however, cannot easily be expressed in figures. Besides, a reliable comparison is hampered by differing yearly environmental conditions. To obtain an impression of the overall quality we have applied the following minimum standards: plant height 1 m, spike length half of the plant height, number of flowers 40, and semi-double flowers 5 cm across. In 1965 only one plant or 0.16 per cent anwered to all of the standards; in 1975 this was 164 plants or 27.1 per cent. That is 170 times more. A very big increase indeed but it also shows that there is still a long way to go before it is anywhere near 100 per cent.

We do not maintain long-term data on perenniality (though many plants are, no doubt, sufficiently perennial), nor do we have information about outdoor culture all the year round. For this we need lines of vegetatively propagated plants, as it would be unjustifiable to sacrifice our outstanding reds for a somewhat risky experiment.

This brings me to a final remark. Reproduction is still the biggest problem, whether by seed or by cuttings. The fertility is still fluctuating and insufficient, and the reproduction of a conspicuous plant by seed is as impossible as it is for the outstanding, blue-flowering cultivars of English origin. It is possible to reproduce stock by cuttings in the usual way but this has not been a great success so far, because of the small numbers of cuttings per plant and only a moderate rooting. This may become much better in due time as, in a recent experiment with cuttings placed in jars with tap water, the rooting was much quicker and reached almost 100 per cent.

Summarizing I may conclude that, after 18 generations, D. University Hybrids still show several imperfections, but when the breeding results at the beginning are compared with those of the present, striking progress can be clearly demonstrated.

References

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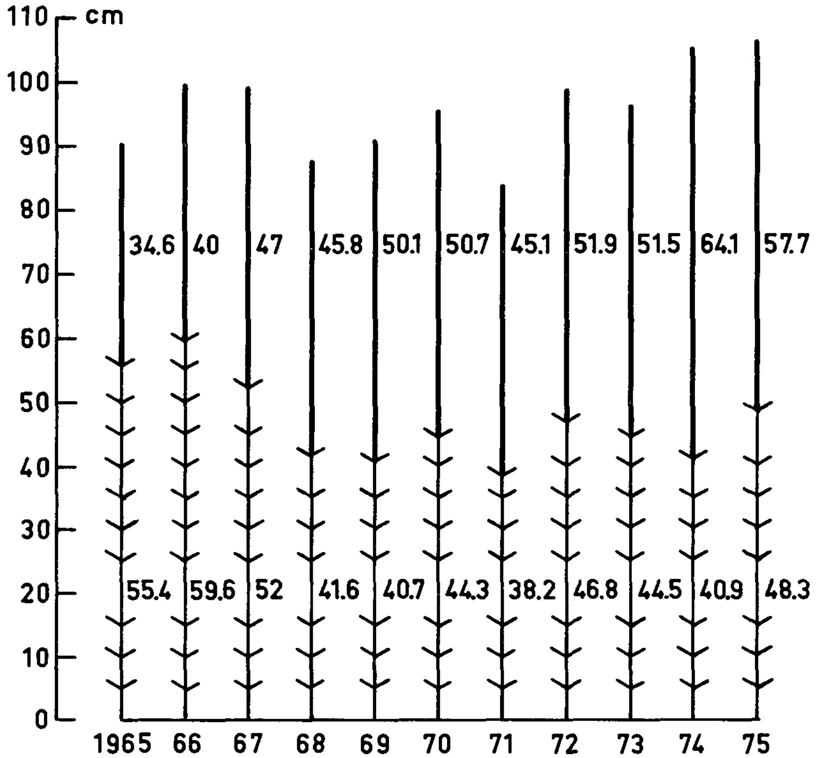

Figure 1 – Average plant height and spike length of eleven consecutive generations of D. University Hybrids

⊥ = stem with leaves | = spike with florets

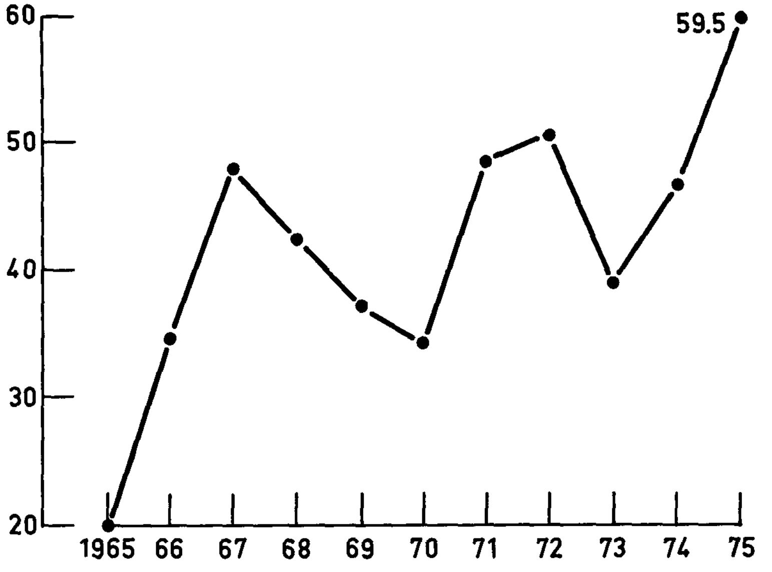

Figure 2 – Average number of flowers per spike

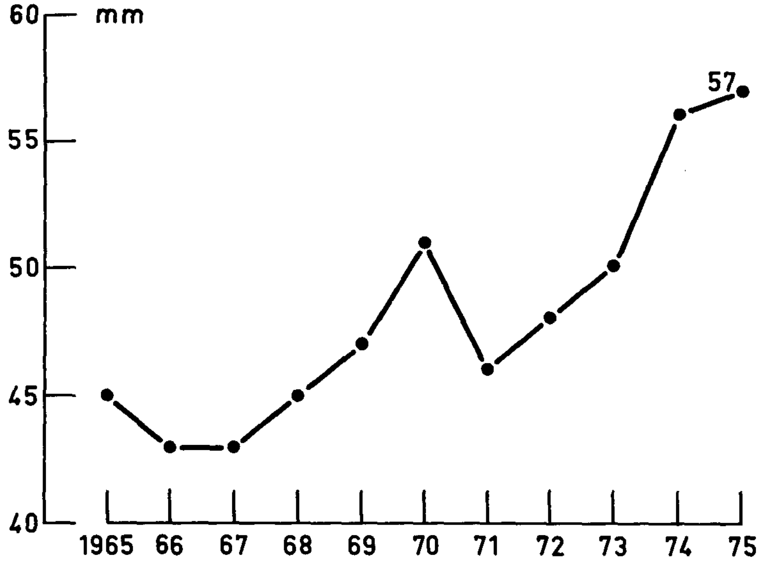

Figure 3 – Average flower diameter in mm