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Short Communication

Variability in interspecific hybrids of *Fuchsia*

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Abstract

***Fuchsia* species are out-breeding, so individuals are likely to be heterozygous for many genes and are propagated vegetatively. Taken together, the F_1 hybrid progeny showed a wide range of phenotype expression ranging from being intermediate between the parents through to the wild type *Fuchsia* flower colour and to the extreme extent, hybrids that did not resemble either parent. In the present interspecific hybridization, the F_1 population of hybrids such as *F. fulgens* x *F. boliviana, F. hatschbachii* x *F. oliviana, F. triphylla* x *F. arborescens, F. triphylla* x *F. boliviana, F. triphylla* x *F. splendens, F. splendens* x *F. trumpetor*, "Timothy Hammett" x *F. boliviana* and "Timothy Hammett" x *F. glazioviana* gave highly variable plants.**

Key words: *Fuchsia,* interspecific hybrids, segregation, variability

Most of the present day fuchsias are the products of decades of cross breeding of cultivars. Previous *Fuchsia* breeders have utilized only a small number of species despite the rich genetic diversity of a genus that contains over 110 species. Consequently, the present day *Fuchsia* cultivars are mostly shrubs with flower colours that range from red through purple to pink and white and only a few species were predominant in the gene pool. These are *F. magellanica, F. fulgens, F. boliviana, F. triphylla* and *F. splendens.* Still, there is a great scope to incorporate other colours and characters into fuchsia by hybridizing between geographically different *Fuchsia* species. In this paper, morphological variability of F_1, interspecific hybrids of *Fuchsia* was given as segregation in the progenies is a very powerful mechanism for creating genetic variation.

An extensive hybridization programme where a total of 1495 flowers utilizing 15 species and 3 cultivars that belong to seven sections of the genus following the classification of Berry *et al*. [1] was carried out in the glass house at the University of Auckland, New Zealand. The morphology of species and hybrids using was examined to study the heritability of the characters from the parents. Leaf characters such as form, margin shape, apices were described using the descriptors given by Evert *et al*. [2] and Lawrence [3]. The colour of floral parts described was recorded using the Horticultural colour chart, issued by the British Colour Council in collaboration with the Royal Horticultural Society [4].

Many combinations, 125 in total, set seed and of these, 15 cross combinations reached to flowering, 44 cross combinations set seeds. Although many of the hybrids that were produced appeared to be reasonably uniform and intermediate between the parents for many/most characters, in several combinations this was not the case with unexpected phenotypes and variation between siblings. Many of the hybrids produced when *F. glazioviana*, *F. magellanica* and *F. hatschbachii* were used as one of the parents in the interspecific hybridizations showed a reversion to the red or purple wild type *Fuchsia* flower colour as the dominant colour. This was seen in *F. boliviano* x *F. glazioviana*, *F. boliviano* x *F.*

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magellanica, *F. glazioviana* x *F. magellanica*, *F. hatschbachii* x *F. boliviano.* In the hybrid between *F. triphylla* and *F. boliviano* in which the parental species are azalea pink 618 and mallow purple respectively, but the progeny all showed up of varying shades of magenta-caramine, crimson-cyclamen purple and rose madder-rhodamine purple flowers. This phenomenon is not unique to *Fuchsia* and in a number of crosses between species and cultivars and between different species in *Lathyrus,* the F_1s revert to the wild type flower colour [5, 6]. The next step that will be required for the future is probably to raise the next generations where there should be recombination and segregation for a range of flower colours and forms. However, the F_1s are not very fertile so this may not be particularly easy and a further avenue may be to induce polyploidy to restore fertility and then use the polyploids for further breeding.

Irrespective of intrachromosomal recombination and assuming all pairs of homologous chromosomes in a diploid are heterozygous at least at one locus, a diploid parent is capable of generating 2^{nd} number of different gamete genotypes, where n is the haploid chromosome number [7]. Further, *Fuchsia* species are out-breeding, so individuals are likely to be heterozygous for many genes and are propagated vegetatively. Taken together, segregation in F_1 population of hybrids such as *F. fulgens* x *F. boliviano*, *F. hatschbachii* x *F. boliviano*, *F. triphylla* x *F. arborescens*, *F. triphylla* x *F. boliviano*, *F. triphylla* x *F. splendens*, *F. splendens* x *F. trumpetor,* "Timothy Hammett" x *F. boliviano* and "Timothy Hammett" x *F. glazioviana* gave highly variable progenies.

Morphological description of segregating F_1 interspecific hybrids

1. F. fulgens x F. boliviana

This interesting hybrid had intermediate plant growth form between both the parental species with vigorous plants. The flowers were entirely different from the both parental species with segregation in population. The sepals were rose madder to rose bengal in colour and petals had rose madder to caramine colours and stamens were positioned at the same level as the style.

2. F. hatschbachii x F. boliviana

The hybrid plant resembled *F. hatschbachii* in plant growth form and intermediate in flower colour that varied in the hybrid plant population. The plants were vigorous and the flowers were rose madder in colour. The anthers and filaments were magenta in colour.

3. F. triphylla x F. arborescens

This entirely different hybrid had shown segregation in F_1 population. The plants were vigorous with profuse flowering. The morphology of plants and flower size varied greatly in the segregating population. The petals were geranium lake to rose madder in colour and in one of the hybrid population, the stamens were totally absent.

4. F triphylla x F. boliviana

This hybrid showed entirely different characters and did not resemble either parental species. The plants were shrubs and vigorous and leaves were elliptic shaped with serrulate margins and acuminate apices (base-truncate). The F_1 hybrid plants had great variation in its flower characters. The flower colour and shape did not resemble any of its parental species. The pendulous flowers varied in colour from geraniumlake, caramine to rose madder petal colours and magenta, crimson to rose madder sepal colours. The stamens were modified as coloured petals in one of the one of the segregating population.

5. F. triphylla x F. splendens

This hybrid showed an interesting combination of both the parental species. The plants were vigorous and resembled *F. splendens* in its flower shape. The petals colour varied from dirty red, scarlet to caramine in the segregating population and sepal colour varied from capsicum red to caramine.

6. F. splendens x F. trumpetor

This interesting hybrid was intermediate in plant growth between two parental species. The plants were vigorous and flowers mostly resembled *F. trumpetor.* The flowers varied from apetalous to petalous and when petals were present, they were fire red in colour.

7. "Timothy Hammett" x F. boliviana

This hybrid resembled "Timothy Hammett" in plant form, leaf shape and size with intermediate to parents in floral characters. The plants were vigorous and the bold flowers had crimson coloured petals with rose madder sepals. The filament was cyclamen in colour with magenta coloured anthers and inserted style.

8. "Timothy Hammett" x F. glazioviana

Some of the segregating plants of this hybrid resembled "Timothy Hammett" and others resembled *F. glazioviana.* Even plants with intermediate plant characters to both the parents were also produced in this cross combination. Plants were dwarf to very vigorous in nature with variation in flower size and some of the plants had colour pigmentation like *F. glazioviana.*

Nonetheless, the morphology of many F_1 *Fuchsia* hybrids indicated that the floral and vegetative characters were intermediate between parents. This is seen, for instance, in *F. boliviana* x *F. magellanica, F. splendens* x *F. trumpetor, F. triphylla* x *F. splendens,* "Timothy Hammett" x *F. glazioviana*, "Timothy Hammett" x *F. boliviana, F. fulgens* x *F. splendens* and *F. hatschbachii* x *F. boliviana*. The intermediate characters that were expressed in some of the F_1 hybrids suggest that these characters are caused by the additive inheritance of traits from both the parents [8]. These findings are in accord with the interspecific hybridizations of *Cyphomandra corynbiflora* and *C. diploconos* [9] and many other interspecific hybrids. In addition to intermediate to parental species, hybrids that were entirely different from both the parents were also produced in this study. They included *F. fulgens* x *F. magellanica, F. triphylla* x *F. boliviana* and *F. triphylla* x *F. arborescens.* A Very different hybrid was also obtained by Chaudhuri (1956) in the intersectional hybrid between *F. magellanica* and *F. fulgens* and he stated that the resultant hybrid showed little obvious similarity to *F. fulgens* [10]. Rieseberg & Carney [11] gave statistics for angiosperm hybrids with respect to their inheritance of characters and stated that these transgressive variations were not only expressed in the first generation but also in the next generation hybrids due to mutations, epistasis or complementary action of genes. It is suggested from their observation that the more similar the phenotype of the parents, the more likely transgressive segregation will be observed for that trait. There are several examples to explain this kind of variation in the interspecific hybridization, but only crosses involving primose and oxlip [12] has been mentioned here.

Finally, the production of new colours or colour combinations by interspecific hybridization involves a great deal of hard work and the success in most cases is unpredictable. For instance, the untiring work of many workers in *Zinnia* interspecific hybridization ultimately yielded a novel hybrid (*Z. angustifolia* var. *angustifolia* x *Z. violacea*) with characters of interest. The reciprocal and other crosses fail to achieve the transfer of the desired flower colour coupled with disease resistance and plant habit. There are many other ornamental plants' where the characters of interest could not be transferred. Once again, a well-known example is the transfer of yellow colour from *Lathyrus belinensis* into its hybrids, this colour is missing from the cultivars of sweet pea still has not been successfully achieved.

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