NEW SWEET PEA (*LATHYRUS ODORATUS*) CULTIVARS VIA INTERSPECIFIC HYBRIDIZATION WITH WILD *LATHYRUS* SPECIES

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Abstract

Interspecific hybridization using wild species of *Lathyrus* has been used to introduce new genes into the sweet pea. Two main goals are being pursued. These are yellow flower colour and improved heat tolerance in *L. odoratus* cultivars. In general hybrids were difficult to make and embryo culture was needed to rescue the embryos in some species combinations. Hybridization was only possible between species with the same overall karyotype pattern. The results of this programme are very encouraging and significant new cultivars are expected in the near future.

Additional index words: embryo rescue, flower pigments, karyotypes

1. Introduction

The sweet pea (*Lathyrus odoratus*) is a major annual flower crop both for the home garden and as a cut flower. It has been cultivated for almost 300 years having been brought to Britain from its native Sicily in 1699. In the wild it has relatively small blue and purple bicoloured flowers but during the process of domestication it has undergone a number of major developments. The earliest, in 1730s was the consequence of a spontaneous mutation leading to plants that no longer produced the blue pigment and these gave rise to the cultivar 'Painted Lady'. By 1800 several more varieties were known, all thought to be new mutants but it was not for another 60 years before serious attempts at hybridization were undertaken. Henry Eckford, working from 1880 onwards, has been credited with the real development of the crop through hybridization and selection. During that time many new cultivars were developed including selections with significantly larger flowers, the grandifloras. Probably the most important development happened in 1900 with the mutation that gave the now familiar frilled petals of the 'Spencer' flower form. There are now approximately 450 extant named cultivars showing a wide variety in flower colour, form and scent that have all been selected from mutants of the wild type that have been recombined within the species i.e. they are examples of the exploitation of intraspecific variation. Despite a very intensive effort, there are two important goals of sweet pea breeding that have not yet been achieved. These are yellow flower colour and heat tolerance, and it must be concluded that these characters are lacking from the gene pool of the species.

Our research programme has had two main aims. These are to expand the gene pool of the sweet pea by interspecific hybridization with wild relatives that have these desired phenotypes and to investigate evolutionary relationships between the

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species that have been suggested to be related to *L. odoratus*. *Lathyrus* is a large genus with 156 species which has been divided into 13 sections (Kupicha, 1983). There are at least eight wild species of *Lathyrus* that have yellow flowers and five of these are found in the same section of the genus as *L. odoratus*. One of these species, *L. belinensis*, which shows the greatest potential has only recently been discovered and described (Maxted et al., 1988). Several species in this section also show potential as sources of genes for heat tolerance.

2. Materials and Methods

The species used are listed in Table 1. With the exception of *L. belinensis*, they are listed in taxonomic order following Kupicha (1983). *L. belinensis* was not described until 1988 and consequently was not included in Kupicha's treatment of the genus. The methods for growing the plants, making hybrids and analysing chromosomes and flower pigments are given in Hammett et al. (1994).

Table 1 - Species of *Lathyrus* used in this study. * = species with yellow flowers.

*L.annuus**
*L. hierosolymitanus**
L. cassius
L. odoratus
L. hirsutus
*L. chloranthus**
*L. chrysanthus**
*L. belinensis**

3. Results and Discussion

A large number of different species combinations have been attempted and the results of our hybridization programme are summarized in Table 2.

Table 2 - Summary of interspecific hybridization programme in *Lathyrus*. + = successful hybridization, - = unsuccessful hybridization, o = cross not made.

	annuus	hiero.	cassius	odor.	belin.	hirsutus	chlor.	chry.
annuus	o	+	o	-	o	o	o	o
hiero.	+	o	o	o	o	o	o	o
cassius	o	o	o	+	+	+	o	o
odor.	o	o	o	o	+	+	-	-
belin.	o	o	o	+	o	o	o	o
hirsutus	o	o	+	+	+	o	o	o
chlor.	o	o	o	-	o	o	o	+
chry.	o	o	o	-	o	o	-	o

Several important observations can be made from these results. First, we have been successful in making a large number of new hybrid combinations but have found that some combinations are very difficult to make whereas others are relatively easy. Second, an important observation has been that successful crosses have been achieved only when the parental species have very similar overall karyotypes. Of the yellow flowered species, the only species that has been successfully crossed with *L. odoratus* was *L. belinensis* and although this was successful, it was initially achieved only following rescue *in vitro* of the hybrid embryos. The results of this cross, where the *L. odoratus* parent was the cream coloured grandiflora cultivar 'Mrs Collier', were somewhat unexpected in that the F_1, instead of exhibiting a blending of the parental phenotypes, showed pink and blue coloured flowers that resembled pale versions of the wild type *L. odoratus*.

These observations on flower colour have led onto studies of flower pigments and we have found that three pigment systems, carotenoids, flavonols and anthocyanins in different proportions and of different kinds, are present in the parental and F_1 plants. There appears to be complementation between the genes that regulate the pigment pathways in the parental species and this results in the F_1 in both the production of new anthocyanins and in different ratios between them and the flavonols.

Although the fertility of the F_1 plants was very low (5% stainable pollen) we have been able to use them in a series of backcrosses to both parents. Subsequent generations have shown considerably improved levels of fertility, which interestingly showed variation between different lines. We have pursued two strategies with these plants, one to make *L. belinensis* more sweet pea like and the other to identify segregants amongst the backcrosses to *L. odoratus* that show yellow colouration. In both cases we have had significant successes and in addition, amongst the *L. odoratus* segregants, there have been a number of completely new flower colours such as intense blue and turquoise.

For heat tolerance, to be specific flower retention at high temperatures, we have two candidate species, *L. latifolius* and *L. hirsutus*. However, in the light of our karyotype studies the most suitable one, *L. latifolius*, has not been utilized as its karyotype is very significantly different from that of *L. odoratus*. *L. hirsutus*, on other hand, has a very similar karyotype to that of *L. odoratus* and these two species are amongst the easiest to cross, despite the very small flowers of *L. hirsutus*. The F_2 generation has shown considerable segregation for a variety of characters and some of the selected lines showed markedly better flower retention at high temperatures than *L. odoratus* cultivars. In addition, further backcrossing to *L. odoratus* has resulted in miniature Spencer type flowers that make interesting new material for cultivar development.

In conclusion, very significant developments of this major floriculture crop are underway and we believe that the sweet pea will be transformed by this infusion of new genetic material.

4. References

Hammett, K.R.W., Murray, B.G., Markham, K.R., and Hallett, I.C., 1994. Interspecific hybridization between *Lathyrus odoratus* and *L. belinensis*. Int. J. Plant Sci. 155: 763-771

Kupicha, F. K., 1983. The infrageneric structure of *Lathyrus*. Notes R. Bot. Gard. Edinb. 41: 209-244

Maxted, N., and Goyder, D.J., 1988. A new species of *Lathyrus* sect. *Lathyrus* (*Leguminosae-Papilionoideae*) from Turkey. Kew Bull. 43: 711-714