

NOTES AND COMMENTS

SYNTHESIS OF THE HYBRID *SENECIO SQUALIDUS* L. × *S. VULGARIS* L. F. *RADIATUS* HEGI

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SUMMARY

Hybrids between *Senecio vulgaris* L. f. *radiatus* Hegi and *S. squalidus* L. were obtained with little difficulty. This is in marked contrast to the experience of other workers attempting the cross using *S. vulgaris* L. f. *vulgaris*. The implication is that the spread of *S. vulgaris* f. *radiatus* may have important effects on the isolation of the species when it is in contact with *S. squalidus*.

1. INTRODUCTION

THE spread of the radiate form of groundsel very closely approximates in time and space the spread of *Senecio squalidus*, and the hypothesis has been advanced that the rayed gene is a result of introgressive hybridisation between the two species (Crisp and Jones, 1970; Crisp, 1972; Hull, 1974*a* and *b*, 1975; Richards, 1975). Introgression involves the surmounting of a very considerable infertility barrier, since *S. squalidus* L. is a diploid ($2n = 20$) and *S. vulgaris* L. is tetraploid ($2n = 40$). Hybridisation does occur in the wild, however, as hybrid swarms are recorded fairly frequently, and the allotetraploid hybrid has been found (*S. cambrensis*, Rosser, 1955). *S. cambrensis* has $2n = 60$, and therefore presumably originated from a triploid hybrid with $2n = 30$. However, no triploid hybrids have been reported from the wild, those hybrids which have been investigated having $2n = 40$ (approx.).

The triploid hybrid has been synthesised, but only with considerable difficulty. Harland (1954) achieved it by using a male sterile form of *S. vulgaris* f. *radiatus* as the female parent. Vosa, in work reported by Crisp (1972) obtained a single hybrid with *S. squalidus* L. as the female parent. Gibbs (1971) reports that hybrid was produced at St Andrews, with *S. vulgaris* as female parent, but the cytology of the hybrid was not checked. Crisp (1972) failed to synthesise it despite repeated attempts.

Here I report the results of a crossing programme between *S. squalidus* and *S. vulgaris* using both rayed and rayless form of *S. vulgaris*.

2. MATERIALS AND METHODS

The origin of the material used is as follows:

S. vulgaris L. f. *vulgaris*: an inbred line derived from a single plant collected from Puffin Island, Anglesey (Abbott, 1976).

S. vulgaris L. f. *radiatus* Hegi: an inbred line bred from a single plant collected at Newcastle-under-Lyme (Campbell and Abbott, 1976).

S. squalidus: progeny of a single plant, collected at Durham by Dr J. L. Crosby.

Emasculation was carried out using the procedure described by Ornduff (1964).

A cytological examination of synthesised hybrids was conducted by anther squashes of material fixed in 6 : 3 : 2 ethanol: chloroform: propionic acid (Arroyo, 1973), and stained with lacto-propionic orcein. Phase contrast was used for photography because intense staining proved difficult. Pollen grains were examined after staining with methyl green and phloxine in glycerine jelly.

3. POLLINATIONS AND RESULTS

S. vulgaris f. *radiatus* (female) \times *S. squalidus* (male)

five emasculated capitula pollinated. Five hybrid plants produced from one capitulum.

Reciprocal

five capitula pollinated (*not* emasculated). One hybrid plant produced.

S. vulgaris f. *vulgaris* (female) \times *S. squalidus* (male)

five emasculated capitula pollinated. No hybrids.

Reciprocal

five emasculated capitula pollinated. No hybrids.

ten capitula (*not* emasculated) pollinated. No hybrids.

4. MORPHOLOGY AND CYTOLOGY OF THE HYBRIDS

Of the six hybrids produced, the one with *S. squalidus* as female parent developed slowly and was late to mature. In other respects it was indistinguishable from the other hybrids.

Vegetatively, the hybrids resembled *S. squalidus* in over-wintering habit, mildew resistance and leaf shape. Leaf pubescence, however, resembled the *vulgaris* parent. At the beginning of their flowering season, the hybrids resembled *S. squalidus* in floral characters, too. The ligules were not noticeably shorter than those of *S. squalidus*, though they were slightly narrower than those of the parental strain. Later in the year, capitulum size decreased and became more obviously intermediate. The hybrids always produced 13 ray florets like *S. squalidus*.

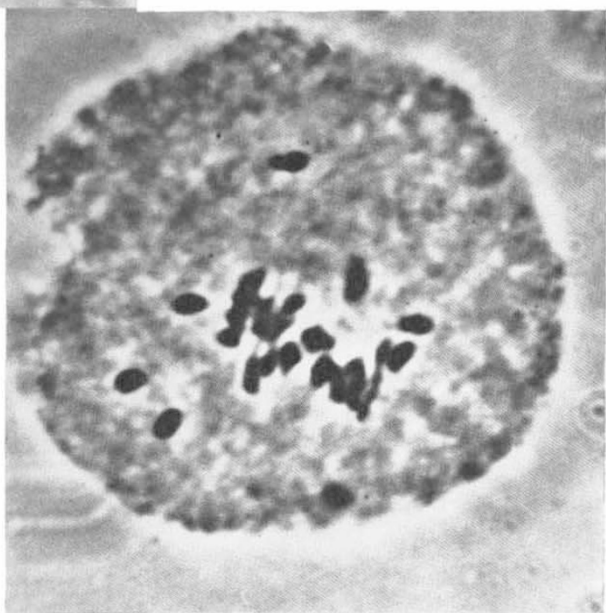
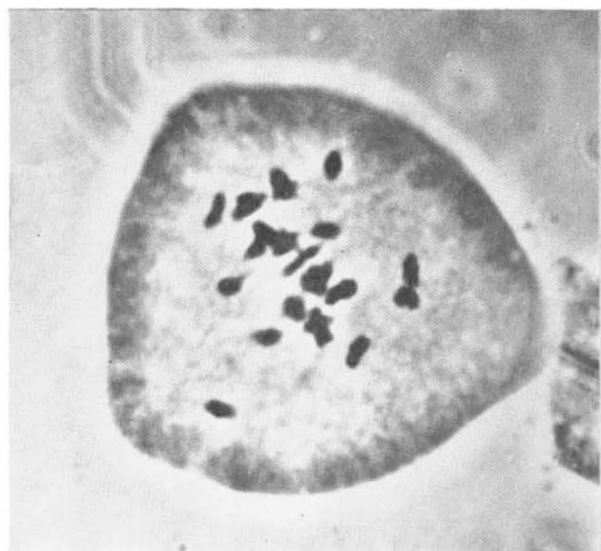
Cytologically, all six hybrids were triploid. Meiosis was very irregular. There were 7 to 10 unpaired chromosomes, with an average of eight. These could be seen most clearly in cells in which the paired chromosomes were clumped on the metaphase plate and the univalents scattered over the cell. The plate shows well-spread cells, which are a little more difficult to interpret, but which show clearly that the rest of the chromosomes form bivalents with one or two multivalents. At anaphase the unpaired chromosomes lag on the spindle.

It is not surprising that the hybrid is very infertile. Examination of the pollen grains showed 82 per cent without contents. The remaining 18 per cent varied greatly in size, some being 1.5 times as large as the grains of *S. vulgaris*. Of the 18 per cent, half had more than three pores, and of these more had four, but a few had five or even six. The number of pores was not correlated with the size of the grain.

So far, no fertile achenes have been produced by any of these hybrids.

Plate

Meiosis in the hybrid. Upper cell: 8 univalents, 9 bivalents, 1 quadrivalent. Middle cell: 7 univalents, 8 bivalents, 2 multivalents. Lower cell: unpaired chromosomes lagging at anaphase.



Vosa is reported by Crisp (1972) to have found a single fertile achene on his hybrid which gave rise to a fertile allohexaploid. Attempts to produce the allohexaploid are being made, along with backcrosses to the parental stocks.

5. DISCUSSION

Although more crosses are needed to substantiate the point, the present study suggests that hybrids between *S. vulgaris* and *S. squalidus* are more easily formed using "rayed" than "rayless" plants. This tends to confirm a suggestion by Crisp (1972) that plants having a history of hybridisation, such as *S. cambrensis* and *S. vulgaris* f. *radiatus*, lose the incompatibility which exists between *S. vulgaris* f. *vulgaris* and *S. squalidus*. The implication is that populations of *S. vulgaris* containing f. *radiatus* are more open to further introgression from *S. squalidus* than those in which the rayed gene does not occur.

The morphological similarity between the hybrid and *S. squalidus* suggests that any naturally occurring hybrid involving f. *radiatus* would probably be overlooked, though of course the hybrid would be sterile. In addition, it could be predicted that any polyploid race based on this hybrid would strongly resemble *S. squalidus*. Attempts to confirm this prediction are now underway.

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