HORTSCIENCE 26(12):1549-1550. 1991.

# Inheritance of Corolla Striping and Flower Colors in *Salpiglossis sinuata*

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*Additional index words.* epistasis, anthocyanins, color intensity, painted tongue

***Abstract.*** **Corolla striping in *Salpiglossis sinuata* Ruiz et Pav6n is controlled by a recessive gene (st). Yellow pigmentation results from the presence of a recessive gene (y) that, when homozygous, is epistatic to genes involved in anthocyanin production. Blue flower pigmentation is recessive to red, bronze, and lavender. A recessive pigment depressing gene *(pd)* gives reduced color saturation.**

*Salpiglossis sinuata* (Solanaceae) is an annual species grown for its colorful petunia-like flowers. A cleistogamous flowering condition that detracts from its ornamental value has been reported to be inherited as a single dominant gene C; red flower color *R* is dominant to yellow, and dilute pigmentation of the corolla edges *d* is recessive to uniformly solid color (Lee et al., 1976).

Salpiglossis owes its ornamental value to the wide range of corolla colors, patterns, and degrees of color saturation present in the species. The present study expands our knowledge of flower genetics to include additional colors and patterns. Four lines homozygous for color, P-1 (red), P-3 (blue-striped), P-4 (yellow), and P-5 (dilute yellow), were used as parents (Erickson et al., 1982). All crosses were made in the greenhouse and plants were grown in 0.7-liter pots under an 18-h photoperiod. This species has a long-day photoperiodic flowering response.

Table 1 summarizes the results of a blue-striped × red nonstriped cross. Striping refers to a prominent white to yellow veination that extends outward from the corolla throat; it is a common pattern in commercial cultivars. Presence of striping is controlled by a single recessive gene, *st*, but the degree of striping can be quite variable. Red was found to be dominant to blue. Blue tones that differ from the clear medium blue of the parent appear in segregating populations. Such blue tones presumably involve modifier genes and gene interactions. Furthermore, blue can be difficult to categorize because of subtle color changes associated with flower aging. Segregants may have redder tones at anthesis, becoming quite blue at senescence. Change in pH associated with flower age has been implicated in these differences in zinnia (Boyle and Stimart, 1989).

In one blue striped × yellow cross, all $F_1$ progeny were bronze (Table 2). The $F_2$ has a 9:3:4 ratio indicating epistasis and the presence of major genes at two loci. A backcross to the yellow parent gave an equal number of bronze and yellow, and to the blue parent a 1:1 ratio of blue and bronze. Again, there was some variation in blue tones. The data suggest an epistatic effect of homozygous recessive yellow genes over genes associated with anthocyanin pigmentation, such as blue, bronze, etc., rather than an interaction (blending) of yellow and blue pigments to give the bronze phenotype. The yellow parent (P-4) has an unexpressed gene for bronze. Evidence that blending of pigments is not involved is shown in a sib mating in a segregating backcross family from a blue × yellow cross, that gave all blue rather than bronze progeny. When the blue parent (P-3) is crossed to a dilute yellow inbred line, P-5, a similar 9:3:4 segregation occurs, but this $F_1$ is lavender instead of bronze (Table 3).

A segregating $F_2$ population of homozygous bronze (originating from the P-3 × P-4 cross) × blue gave 42 bronze and 19 blue for a 3:1 ratio $(P > 0.30)$, confirming that blue is recessive to bronze, as it is to red, with a single gene difference.

In the P-1 x P-3 cross, a few pale blue $F_2$ segregants appeared. These were found to be homozygous when progeny tested. When crossed to the medium blue P-3 parent, the $F_2$ population revealed that the pale phenotype was due to a single recessive gene [18 medium blue, 6 pale blue ( $P = 1.0$ for a

Received for publication 11 Feb. 1991. Purdue Univ. Agricultural Experiment Station Journal Paper no. 12,855. Study was conducted as an undergraduate research project of P.C. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Table 1. Segregation in a cross between two inbred lines of salpiglossis homozygous for red nonstriped or blue striped corollas.

| | Flower color | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Red | | Blue | | | | | |
| Generation | Nonstriped | Striped | Nonstriped | Striped | Total | Ratio | $\chi^2$ | *P* |
| Parents | | | | | | | | |
| P-1 *StSt* | + | | | | | | | |
| P-3 *stst* | | | | + | | | | |
| $F_1$, $F_2$, and $BC_1$ | | | | | | | | |
| $F_1$ | All | | | | | | | |
| $F_2$ | 114 | 36 | 33 | 9 | 192 | 9:3:3:1 | 1.33 | >0.50 |
| $BC_1$ (to P-1) | All | | | | | | | |
| $BC_1$ (to P-3) | 59 | 37 | 54 | 49 | 199 | 1:1:1:1 | 5.40 | >0.10 |

*Expectation ratios for red vs. blue and nonstriped vs. striped corolla*

| | Red vs. blue | | | | Nonstriped vs. striped | | | |
|---|---|---|---|---|---|---|---|---|
| | Ratios | | | | Ratios | | | |
| | Observed | Expected | $\chi^2$ | *P* | Observed | Expected | $\chi^2$ | *P* |
| Generation | | | | | | | | |
| $F_2$ | 150:39 | 3:1 | 1.81 | >0.10 | 141:48 | 3:1 | 0.03 | >0.05 |
| $BC_1$ (to P-3) | 96:103 | 1:1 | 0.25 | >0.50 | 113:86 | 1:1 | 2.76 | >0.05 |

Table 2. Segregation in a cross between two inbred lines of salpiglossis for blue-striped or solid yellow corollas.

| Generation | Flower color | | | Total | Ratio | $\chi^2$ | *P* |
|---|---|---|---|---|---|---|---|
| | Blue, striped | Solid yellow | Bronze, striped | | | | |
| Parents | | | | | | | |
| P-3 (*YYstst*) | + | | | | | | |
| P-4 (*yystst*) | | + | | | | | |
| $F_1$, $F_2$ and $BC_1$ | | | | | | | |
| $F_1$ | | | All | | | | |
| $F_2$ | 13[z] | 22 | 65 | 100 | 3:4:9 | 3.70 | >0.20 |
| $BC_1$ (to P-3) | 58[z] | | 58 | 116 | 1:1 | 0 | 1.00 |
| $BC_1$ (to P-4) | | 80 | 84 | 164 | 1:1 | 0.09 | >0.60 |

[z]Variable blue tones and pigment saturation among segregants.

Table 3. Segregation in a cross between two inbred lines of salpiglossis for blue-striped and dilute yellow corollas.

| Generation | Flower color | | | Total | Ratio | $\chi^2$ | *P* |
|---|---|---|---|---|---|---|---|
| | Blue, striped | Dilute yellow | Lavender, striped | | | | |
| Parents | | | | | | | |
| P-3 (*YYstst*) | + | | | | | | |
| P-5 (*yystst*) | | + | | | | | |
| $F_1$, $F_2$, and $BC_1$ | | | | | | | |
| $F_1$ | | | All | | | | |
| $F_2$ | 19[z] | 20 | 59 | 98 | 3:4:9 | 0.88 | >0.60 |
| $BC_1$ (to P-3) | 93[z] | | 79[z] | 172 | 1:1 | 1.14 | >0.30 |
| $BC_1$ (to P-5) | | 43 | 49[z] | 93 | 1:1 | 0.39 | >0.50 |

[z]Variable pigment saturation and hue among segregants.

3:1 ratio)]. When this recessive gene was incorporated in the yellow phenotype, a pigment reduction also occurred, suggesting it may have a general effect on color intensity. The symbol *pd* (pigment depressing) is proposed.

In an earlier paper (Lee et al., 1976), yellow flower color was stated to be a recessive allele of red and designated r-, with red being *R* –. Based on present evidence, this conclusion needs to be revised. The symbol y is proposed for the epistatic recessive gene that blocks formation of anthocyanin pigments, resulting in yellow flowers when homozygous. The dominant Y– permits anthocyanin expression. Also, *st is* proposed for the striping pattern, with dominant *St* – being nonstriped. The striped phenotype cannot be detected in yellow flowers because the striping itself is yellow, or whitish, so the two alleles are indistinguishable in a yellow background. Among the blues, reds, bronzes, etc., blue is recessive to the others and red is dominant, but the number of genes involved in anthocyanin production and their allelic relationships have not yet been fully determined. The symbol *R is* retained for red corolla.

### Literature Cited

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