

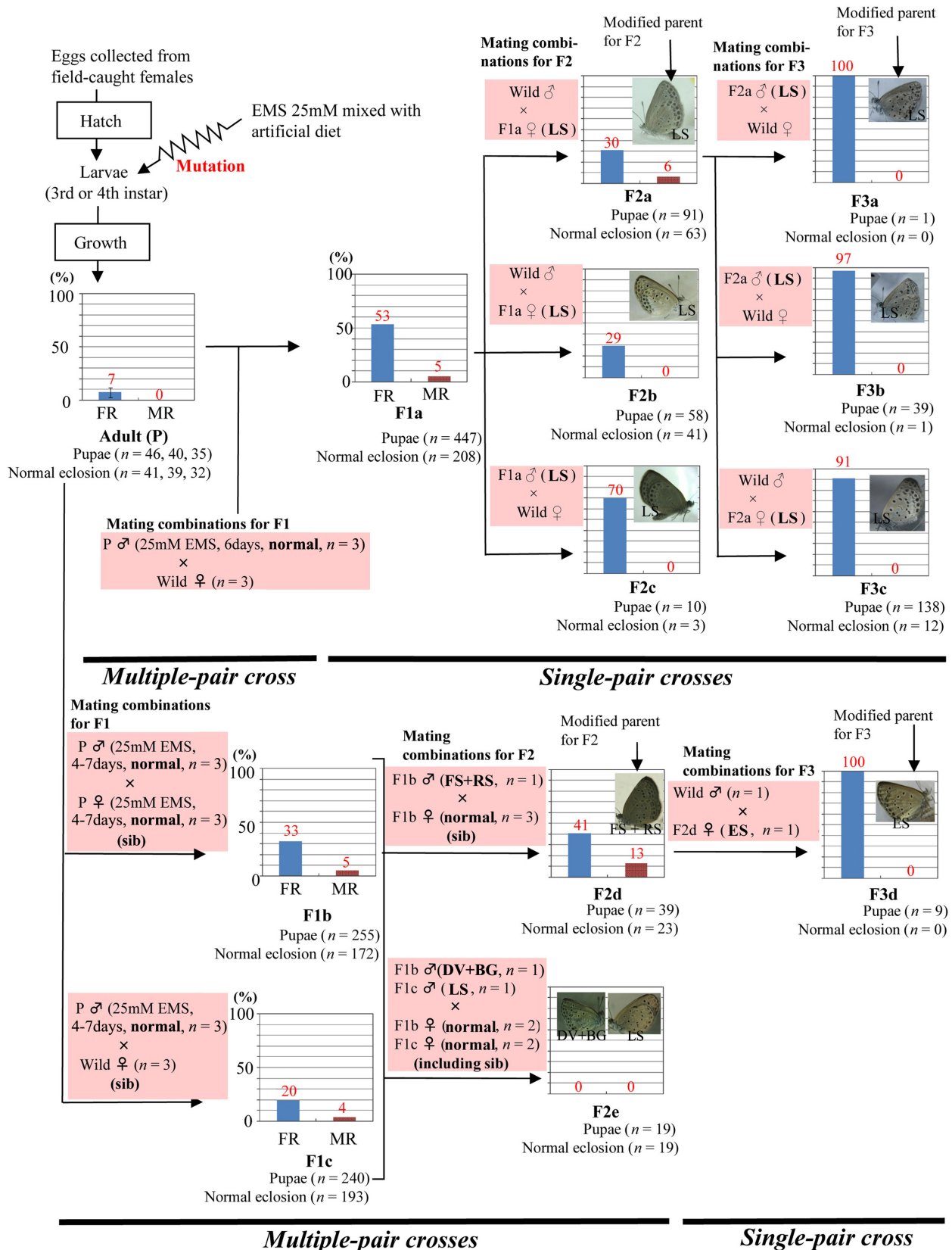
# **SUPPLEMENTARY INFORMATION**

## **System-dependent regulations of colour-pattern development: a mutagenesis study of the pale grass blue butterfly**

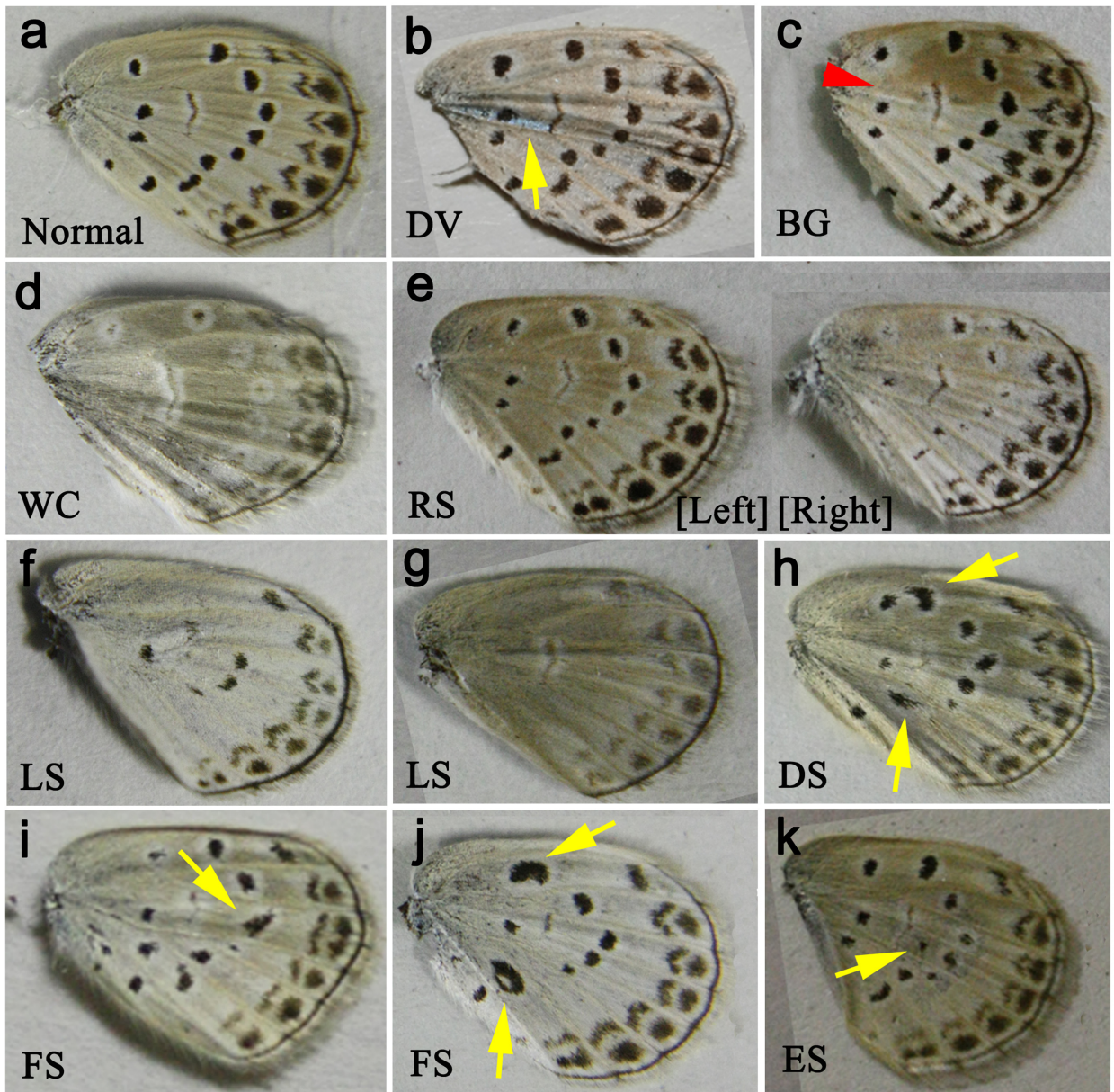
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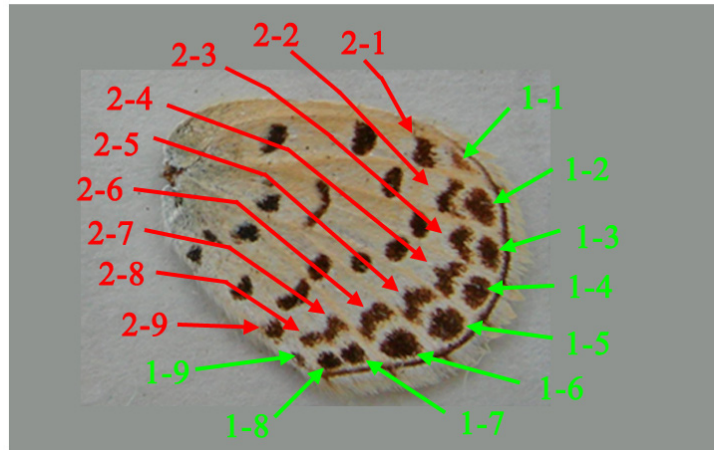
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**Supplementary Figure 1 | Crosses performed in this study and their results.** The parents used for a cross are shown in a pink box. Also see Supplementary Tables 1-8. The failure rate (FR) and the modification rate (MR) are shown together with the number of individuals that were obtained at the bottom of each bar graph. The offspring of each cross are named F<sub>1</sub>a, F<sub>1</sub>b, and so on.

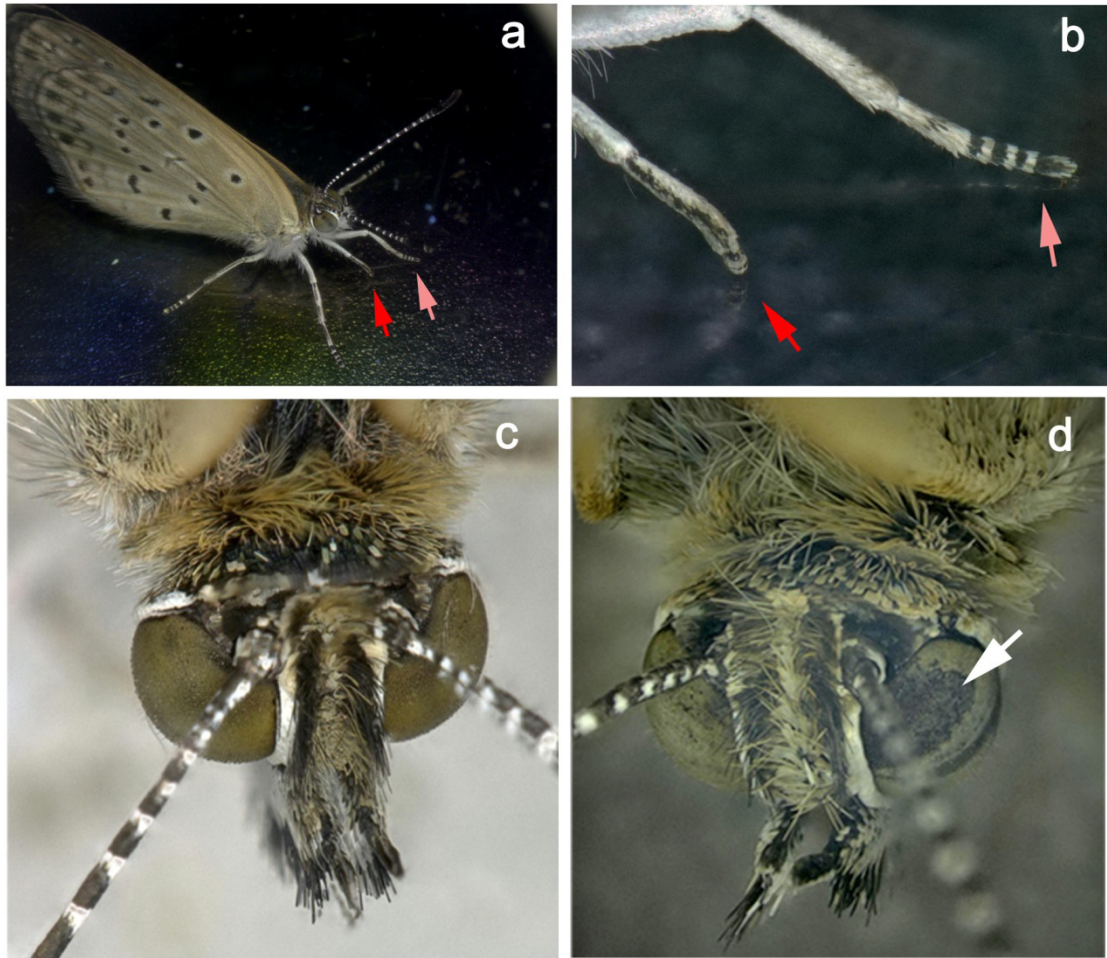


**Supplementary Figure 2 | Wing modifications obtained in the  $F_1$  and  $F_2$  mutants.** Wing sizes were adjusted to be similar to one another so that one can compare their colour patterns easily. Aberrant spots and regions were indicated by yellow arrows, and an aberrant background gap was indicated by a red arrowhead. **(a)** Normal wing colour pattern. **(b)** DV (dorsoventral transformation). **(c)** Background gap (BG). **(d)** Weak contrast (WC). **(e)** Reduction of spots (RS). In this particular individual, the left wing was normal, whereas the right wing showed the RS phenotype (the image of the right wing was reverted). **(f, g)** Loss of spots (LS). **(h)** Disarrangement of spots. **(i, j)** Fusion of spots (FS). **(k)** Ectopic spot (ES).



**Supplementary Figure 3 | Nomenclature of spots that belong to the first and second spot arrays.** Spots were numbered from the anterior side to the posterior side. Spots that belong to the third and fourth arrays were similarly named (see Fig. 5a).





**Supplementary Figure 4 | Non-wing aberrations found in the F<sub>1</sub> mutants.** (a, b) Aberrant foreleg tips of a female F<sub>1a</sub> mutant. Forelegs are sexually dimorphic in this butterfly. In this individual, the left foreleg is female (pink arrows), whereas the right foreleg is male (red arrows) in morphology. (c, d) Aberrant compound eyes of an F<sub>1f</sub> mutant. Normal eyes are shown in c. Aberrant eye mosaicism is indicated by a white arrow in d.

**Supplementary Table 1 | Rearing experiments without EMS treatment.**

Generation (ND or AD)	Parents of this generation	Pupae ( <i>n</i> )	Normal eclosion ( <i>n</i> )	<i>FR</i> (%)	<i>MR</i> (%)	Panda type with non-deformed wings ( <i>n</i> )	Panda type with deformed wings ( <i>n</i> )	Crescent type with non-deformed wings ( <i>n</i> )	Crescent type with deformed wings ( <i>n</i> )	Wing-size asymmetry ( <i>n</i> )
< Experiment 1 > Natural diet (host plant), sibling crosses, founding parents caught in Okinawa Island										
P(ND)	FC	69	51	26.1	0.0	0	0	0	0	0
F <sub>1</sub> (ND)	P(ND)	71	70	1.5	0.0	0	0	0	0	0
F <sub>2</sub> (ND)	F <sub>1</sub> (ND)	288	236	18.1	0.0	0	0	1	0	0
F <sub>3</sub> (ND)	F <sub>2</sub> (ND)	122	42	65.6	0.0	10	12	1	0	1
< Experiment 2 > Natural diet (host plant), non-sibling crosses, founding parents caught in Kobe (Hyogo Prefecture)										
P(ND)	FC	125	114	9.7	0.0	0	0	0	0	0
F <sub>1</sub> (ND)	P(ND)	277	254	8.3	0.0	0	0	0	0	0
< Experiment 3 > Natural or artificial diet, non-sibling crosses, founding parents caught in Okinawa Island										
P(ND)	FC	30	30	6.7	0.0	0	0	0	0	0
P(AD)	FC	30	28	0.0	0.0	0	0	0	0	0
F <sub>1</sub> (ND)	P(AD)	10	10	0.0	0.0	0	0	0	0	0
F <sub>1</sub> (AD)	P(AD)	37	30	18.9	0.0	0	0	0	0	0

Note: ND, reared on natural diet; AD, reared on artificial diet; FC, field-caught; FR, failure rate; MR, modification rate.

**Supplementary Table 2 | Summary of aberrations found in the mutagenesis experiments.**

Cross ID	Normal eclosion (n)	Colour-pattern modifications (n) [%]	Aberrant legs (n) [%]	Aberrant eyes (n) [%]	PTN (n) [%]	PTD (n)	CTN (n) [%]	CTD (n)	Wing-size asymmetry (n) [%]
P reared with ND (no EMS)	270	0 [0%]	0 [0%]	0 [0%]	1 [0.4%]	0	0 [0%]	0	0 [0%]
P reared with AD (no EMS)	42	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
P reared with AD (2.5 mM EMS)	36	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
P reared with AD (25 mM EMS)	112	0 [0%]	1 [0.9%]	0 [0%]	0 [0%]	0	0 [0%]	0	0
P reared with AD (50 mM EMS)	28	1 [3.6%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [3.6%]
P reared with AD (100 mM EMS)	40	8 [20.0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	2 [5.0%]
P reared with AD (250 mM EMS)	7	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F <sub>1a</sub>	208	10 [4.8%]	1 [0.5%]	0 [0%]	0 [0%]	0	0 [0%]	0	12 [5.8%]
F <sub>1b</sub>	172	8 [4.7%]	0 [0%]	0 [0%]	0 [0%]	1	1 [0.6%]	0	10 [5.8%]
F <sub>1c</sub>	193	7 [3.6%]	1 [0.5%]	0 [0%]	0 [0%]	0	0 [0%]	0	6 [3.1%]
F <sub>1d</sub>	103	1 [1.0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [1.0%]
F <sub>1e</sub>	176	4 [2.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	4 [2.3%]
F <sub>1f</sub>	34	2 [5.9%]	0 [0%]	1 [2.9%]	0 [0%]	0	0 [0%]	0	0 [0%]
F <sub>1g</sub>	9	3 [33.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	2 [22.2%]
F <sub>2a</sub>	63	4 [6.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [1.6%]
F <sub>2b</sub>	41	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	3 [7.3%]
F <sub>2c</sub>	3	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F <sub>2d</sub>	23	3 [13.0%]	0 [0%]	0 [0%]	0 [0%]	0	1 [4.3%]	0	0 [0%]
F <sub>2e</sub>	19	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [5.3%]
F <sub>3a</sub>	1	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F <sub>3b</sub>	0	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F <sub>3c</sub>	12	0 [0%]	0 [0%]	0 [0%]	1 [8.3%]	0	1 [8.3%]	0	0 [0%]
F <sub>3d</sub>	0	0 [0%]	0 [0%]	0 [0%]	0 [0%]	1	0 [0%]	1	0 [0%]

Note: ND, natural diet (host plant leaves); AD, artificial diet; PTN, panda type with non-deformed wings; PTD, panda type with deformed wings; CTN, crescent type with non-deformed wings; CTD, crescent type with deformed wings.

**Supplementary Table 3 | Modification types of the P adults treated with 100 mM EMS.**

Modification types	50 mM EMS ( <i>n</i> )	100 mM EMS ( <i>n</i> )
VS (Vague spot)	1	0
LS (Loss of spot)	0	7
RS (Reduction of spot)	0	1
ES (Ectopic spot)	0	1
WC (Weak contrast)	0	2
<b>Total</b>	<b>1</b>	<b>11</b>

Note: Double count was allowed when an individual showed two modification traits.

**Supplementary Table 4 | Mating combinations of parents to obtain the F<sub>1</sub> mutants.**

Cross ID	Male and female adults for cross	Parents ( <i>n</i> )	Pupae ( <i>n</i> )	Normal eclosion ( <i>n</i> )	Colour-pattern modifications ( <i>n</i> )	<i>FR</i> (%)	<i>MR</i> (%)
F <sub>1a</sub>	P males reared with 25 mM EMS for 6 days Wild-type females reared with natural diet (host plant)	♂3 ♀3	447	208	10	53.4	4.8
F <sub>1b</sub>	P males reared with 25 mM EMS for 4-7 days P females reared with 25 mM EMS for 4-7 days	♂3 ♀3 (sib)	255	172	8	32.5	4.7
F <sub>1c</sub>	P males reared with 25 mM EMS for 4-7 days Wild-type females reared with natural diet (host plant)	♂3 ♀3 (sib)	240	193	7	19.6	3.6
F <sub>1d</sub>	P males reared with 25 mM EMS for 3 days Wild-type females reared with natural diet (host plant)	♂3 ♀3	332	103	1	69.0	1.0
F <sub>1e</sub>	P males reared with 25 mM EMS for 5 days P females reared with 25 mM EMS for 6 days	♂3 ♀3	285	176	4	38.3	2.3
F <sub>1f</sub>	P males reared with 50 mM EMS for 4-6 days Wild-type females reared with natural diet (host plant)	♂3 ♀3	49	34	2	30.6	5.9
F <sub>1g</sub>	P males reared with 50 mM EMS for 2-5 days Wild-type females reared with natural diet (host plant)	♂3 ♀3	23	9	3	60.9	33.3
<b>Total</b>			1,631	895	35	43.5 (mean)	7.9 (mean)

Note: P indicates parent generation. A sibling cross is indicated as “sib”. All individuals used for crosses showed normal colour patterns.



**Supplementary Table 5 | Modification types of the F<sub>1</sub> and F<sub>2</sub> mutants.**

Modification types	F <sub>1</sub> a	F <sub>1</sub> b	F <sub>1</sub> c	F <sub>1</sub> d	F <sub>1</sub> e	F <sub>1</sub> f	F <sub>1</sub> g	F <sub>2</sub> a	F <sub>2</sub> d	Total
LS (Loss of spots)	7	5	3	0	2	1	2	2	2	24
RS (Reduction of spots)	7	5	3	0	1	1	2	1	1	21
DS (Dislocation of spots)	0	1	2	0	0	0	2	1	0	6
FS (Fusion of spots)	0	2	0	0	0	1	0	0	0	3
BG (Background gap)	0	1	1	0	0	0	1	0	0	3
ES (Ectopic spot)	1	0	1	0	0	0	0	0	1	3
WC (Weak contrast)	0	0	0	1	2	0	0	0	0	3
DV (Dorsoventral transformation)	0	0	1	0	0	0	0	1	0	2
<b>Total</b>	<b>15</b>	<b>14</b>	<b>11</b>	<b>1</b>	<b>5</b>	<b>3</b>	<b>7</b>	<b>5</b>	<b>4</b>	<b>65</b>

Note: Double count was allowed when an individual showed two modification traits.

**Supplementary Table 6 | Crosses of the P adults to obtain the F<sub>1</sub> mutants.**

Male and female adults for cross	Trials ( <i>n</i> )	Success ( <i>n</i> )	Failure ( <i>n</i> )	Success rate (%)	Progeny (Mutant lines)
P ♂ reared with artificial diet ( <i>n</i> = 4) P ♀ reared with artificial diet ( <i>n</i> = 2)	1	1	0	100	NA
P ♂ reared with 25 mM EMS ( <i>n</i> = 3) Wild ♀ ( <i>n</i> = 3)	3	3	0	100	F <sub>1</sub> a, F <sub>1</sub> c, F <sub>1</sub> d
P ♂ reared with 25 mM EMS ( <i>n</i> = 3) P ♀ reared with 25 mM EMS ( <i>n</i> = 3)	2	2	0	100	F <sub>1</sub> b, F <sub>1</sub> e
P ♂ reared with 50 mM EMS ( <i>n</i> = 3) Wild ♀ ( <i>n</i> = 3)	2	2	0	100	F <sub>1</sub> f, F <sub>1</sub> g
P ♂ reared with 100 mM EMS ( <i>n</i> = 3) Wild ♀ ( <i>n</i> = 3)	1	0	1	0	NA
P ♂ reared with 100 mM EMS ( <i>n</i> = 2) P ♀ reared with 100 mM EMS ( <i>n</i> = 2)	1	0	1	0	NA
<b>Total</b>	<b>10</b>	<b>8</b>	<b>2</b>	<b>80</b>	

Note: When an adult was obtained from a given cross, that cross was counted as success. NA, not applicable.

**Supplementary Table 7 | Crosses of the F<sub>1</sub> adults to obtain the F<sub>2</sub> mutants.**

Male and female adults for cross	Trials ( <i>n</i> )	Success ( <i>n</i> )	Failure ( <i>n</i> )	Success rate (%)	Progeny (Mutant lines)
F <sub>1a</sub> ♂ modified ( <i>n</i> = 1) Wild ♀ ( <i>n</i> = 1)	2	1	1	50	F <sub>2c</sub>
Wild ♂ ( <i>n</i> = 1) F <sub>1a</sub> ♀ modified ( <i>n</i> = 1)	2	2	0	100	F <sub>2a</sub> , F <sub>2b</sub>
F <sub>1b</sub> ♂ modified ( <i>n</i> = 1) F <sub>1b</sub> ♀ non-modified ( <i>n</i> = 4)	2	1	1	50	F <sub>2d</sub>
F <sub>1c</sub> ♂ modified ( <i>n</i> = 1) F <sub>1c</sub> ♀ non-modified ( <i>n</i> = 1)	1	0	1	0	NA
F <sub>1b</sub> ♂ modified ( <i>n</i> = 1), F <sub>1c</sub> ♂ modified ( <i>n</i> = 1) F <sub>1b</sub> ♀ non-modified ( <i>n</i> = 2), F <sub>1c</sub> ♀ non-modified ( <i>n</i> = 2)	1	1	0	100	F <sub>2e</sub>
F <sub>1f</sub> ♂ modified ( <i>n</i> = 1) Wild ♀ ( <i>n</i> = 1)	1	0	1	0	NA
<b>Total</b>	<b>9</b>	<b>5</b>	<b>4</b>	<b>56</b>	

Note: When an adult was obtained from a given cross, that cross was counted as success. NA, not applicable.

**Supplementary Table 8 | Crosses of the F<sub>2</sub> adults to obtain the F<sub>3</sub> mutants.**

Male and female adults for cross	Trials ( <i>n</i> )	Success ( <i>n</i> )	Failure ( <i>n</i> )	Success rate (%)	Progeny (Mutant lines)
Wild ♂ ( <i>n</i> = 1) F <sub>2a</sub> ♀ modified ( <i>n</i> = 1)	1	1	0	100	F <sub>3c</sub>
F <sub>2a</sub> ♂ modified ( <i>n</i> = 1) Wild ♀ ( <i>n</i> = 1)	3	2	1	33	F <sub>3a</sub> , F <sub>3b</sub>
F <sub>2a</sub> ♂ non-modified ( <i>n</i> = 4) F <sub>2a</sub> ♀ non-modified ( <i>n</i> = 4)	2	0	2	0	NA
F <sub>2b</sub> ♂ non-modified ( <i>n</i> = 4) F <sub>2b</sub> ♀ non-modified ( <i>n</i> = 4)	1	0	1	0	NA
Wild ♂ ( <i>n</i> = 1) F <sub>2d</sub> ♀ modified ( <i>n</i> = 1)	2	1	1	50	F <sub>3d</sub>
F <sub>2d</sub> ♂ modified ( <i>n</i> = 1) Wild ♀ ( <i>n</i> = 1)	1	0	1	0	NA
F <sub>2d</sub> ♂ non-modified ( <i>n</i> = 1) Wild ♀ ( <i>n</i> = 1)	2	0	2	0	NA
<b>Total</b>	<b>12</b>	<b>4</b>	<b>8</b>	<b>33</b>	

Note: When an adult was obtained from a given cross, that cross was counted as success. NA, not applicable.

**Supplementary Table 9 | Presence or absence of the spots that belong to the first and second spot arrays in the normal-type male individuals.**

Male No.	Wing side	1st spot array									2nd spot array								
		1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9
No. 01	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 02	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No. 03	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 04	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 05	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 06	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 07	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 08	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 09	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No. 10	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 11	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 12	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 13	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No. 14	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 15	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 16	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 17	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 18	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 19	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 20	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 21	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 22	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 23	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 24	Right wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 25	Right wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Note: Black dots (●) and bars (-) indicate full spots existing and no spots, respectively. We used the first-array spots from 1-2 to 1-8 (excluding 1-1 and 1-9) and the second-array spots from 2-2 to 2-8 (excluding 2-1 and 2-9) for identifying the LS and RS types, because other spots may be lost even in the normal type. We have seen normal individuals that lacked the 1-1 or 2-1 spots, although rare and not listed in this table. See Supplementary Fig. 3 for the definition of spots.



**Supplementary Table 11 | Presence or absence of the spots that belong to the third and fourth spot arrays in the normal-type male individuals.**

Male No.	Wing side	3rd spot array									4th spot array					
		3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	4-1	4-2	4-3	4-4	4-5	4-6
No. 01	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 02	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 03	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 04	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 05	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 06	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 07	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 08	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 09	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 10	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 11	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 12	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 13	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 14	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 15	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 16	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 17	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 18	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 19	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 20	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 21	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 22	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 23	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 24	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 25	Right wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
	Left wing	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-

Note: Black dots (●) and bars (-) indicate full spots existing and no spots, respectively. We used the third-array spots from 3-1 to 3-9 (excluding 3-8) and the fourth-array spots from 4-3 to 4-4 for identifying the LS and RS types, because other spots may be lost even in the normal type. See Fig. 5a for the definition of spots.





**Supplementary Table 13 | Presence or absence of the spots that belong to the first and second spot arrays in the P-generation individuals treated with 100 mM EMS.**

No.	Sex	Genotype	Wing side	1st spot array									2nd spot array								
				1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9
No. 01	P, Male	(LS)	Right (M)	●	●	●	●	●	●	-	-	-	●	●	●	●	●	●	-	-	-
			Left (M)	●	●	●	●	●	●	-	-	-	●	●	●	●	●	●	-	-	-
No. 02	P, Male	(LS)	Right (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
			Left (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No.01	P, Female	(LS)	Right (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
			Left	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No.02	P, Female	(LS)	Right (M)	●	●	●	●	●	●	-	-	-	●	●	●	●	●	●	●	●	●
			Left	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No.03	P, Female	(LS)	Right (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
			Left (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No.04	P, Female	(LS)	Right (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	-	-	-
			Left (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-
No.05	P, Female	(LS+RS)	Right (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	-	-
			Left (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-

Note: See explanations in Supplementary Table 9. Identification of modified wings (indicated as “M”) depends not only on the first- and second-array spots but also the third- and fourth-array spots (not shown in this table but see Supplementary Table 14). Only the LS- or RS-type individuals were listed in this table.

**Supplementary Table 14 | Presence or absence of the spots that belong to the third and fourth spot arrays in the P-generation individuals treated with 100 mM EMS.**

No.	Sex	Genotype	Wing side	3rd spot array									4th spot array								
				3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	4-1	4-2	4-3	4-4	4-5	4-6			
No. 01	P, Male	(LS)	Right (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
			Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-
No. 02	P, Male	(LS)	Right (M)	●	●	●	●	●	●	-	-	●	●	-	●	-	●	●	-	-	
			Left (M)	●	●	●	●	●	●	-	-	●	●	-	●	-	●	●	-	-	
No.01	P, Female	(LS)	Right (M)	●	●	●	●	-	●	●	-	●	-	●	-	●	-	●	●	-	-
			Left	●	●	●	●	●	●	●	●	●	●	-	●	-	●	●	-	●	
No. 02	P, Female	(LS)	Right (M)	●	●	●	●	-	●	●	●	●	●	●	●	-	●	●	-	-	
			Left	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
No.03	P, Female	(LS)	Right (M)	●	●	●	●	●	●	-	-	●	-	●	-	-	●	●	-	-	
			Left (M)	●	●	●	●	-	●	-	-	●	-	●	-	●	●	-	-		
No.04	P, Female	(LS)	Right (M)	●	●	●	●	-	●	●	●	-	●	-	●	-	●	●	-	-	
			Left (M)	●	●	●	●	●	●	●	●	-	●	-	●	-	●	●	-	-	
No.05	P, Female	(LS + RS)	Right (M)	●	●	●	●	-	●	○	○	●	-	●	-	●	●	-	-		
			Left (M)	●	●	●	●	○	●	-	-	●	-	●	-	●	●	-	-		

Note: See explanations in Supplementary Tables 9 and 13. Identification of modified wings (indicated as “M”) depends not only on the third- and fourth-array spots but also the first- and second-array spots (not shown in this table but see Supplementary Table 13). Only the LS- or RS-type individuals were listed in this table.

**Supplementary Table 15 | Presence or absence of the spots that belong to the first and second spot arrays in the F<sub>1</sub>-generation individuals.**

	Male/Female (LS/RS)	Wing side	1st spot array									2nd spot array								
			1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9
No. 01	F1a, Male (LS)	Right (M)	●	●	●	●	●	●	-	-	-	●	●	●	●	●	●	●	-	
		Left (M)	-	-	●	●	●	●	●	-	-	●	●	●	●	●	●	●	-	
No. 02	F1a, Male (RS)	Right	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
		Left (M)	-	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 03	F1a, Male (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	-	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
No. 04	F1a, Male (LS + RS)	Right (M)	-	●	●	●	●	●	●	-	-	●	●	●	●	●	●	●	-	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 05	F1a, Male (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 06	F1a, Male (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 07	F1b, Male (LS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
		Left (M)	●	●	●	●	●	●	●	-	●	-	●	●	●	●	●	●	-	
No. 08	F1b, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 09	F1b, Male (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 10	F1b, Male (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 11	F1c, Male (LS + RS)	Right (M)	-	○	●	○	○	○	●	●	-	○	○	○	○	○	○	●	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 12	F1c, Male (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 13	F1c, Male (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 14	F1e, Male (LS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 15	F1g, Male (LS + RS)	Right (M)	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	-	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 01	F1a, Female (LS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 02	F1a, Female (RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	○	○	○	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	○	○	○	
No. 03	F1a, Female (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 04	F1b, Female (LS)	Right (M)	●	-	●	●	●	●	●	-	●	-	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 05	F1b, Female (LS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
No. 06	F1b, Female (RS)	Right	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 07	F1b, Female (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 08	F1e, Female (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
No. 09	F1f, Female (LS)	Right (M)	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 10	F1f, Female (RS)	Right (M)	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	-	
		Left	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●	
No. 11	F1g, Female (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		Left (M)	●	○	○	●	●	●	●	●	-	●	○	○	●	●	●	●	-	

Note: See explanations in Supplementary Tables 9 and 13.

**Supplementary Table 16 | Presence or absence of the spots that belong to the third and fourth spot arrays in the F<sub>1</sub>-generation individuals.**

No.	Male/Female (LS/RS)	Wing side	3rd spot array									4th spot array								
			3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	4-1	4-2	4-3	4-4	4-5	4-6			
No. 01	F1a, Male (LS)	Right (M)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
		Left (M)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
No. 02	F1a, Male (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-		
		Left (M)	○	○	○	●	●	●	●	○	●	●	●	-	●	●	-	-		
No. 03	F1a, Male (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-		
		Left (M)	○	○	○	○	○	-	○	○	-	○	○	-	○	●	●	-	-	
No. 04	F1a, Male (LS + RS)	Right (M)	●	-	○	●	●	●	●	●	●	●	●	-	-	●	●	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
No. 05	F1a, Male (LS + RS)	Right (M)	-	-	-	-	-	○	○	-	-	-	-	-	-	○	○	-	-	
		Left (M)	●	○	-	-	○	●	-	-	●	-	-	●	-	●	●	-	-	
No. 06	F1a, Male (LS + RS)	Right (M)	●	○	●	●	●	●	●	●	●	●	●	-	-	●	●	-	-	
		Left (M)	●	-	○	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
No. 07	F1b, Male (LS)	Right (M)	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●	
		Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 08	F1b, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●	
		Left (M)	●	●	●	●	●	-	●	●	●	●	●	●	●	-	●	●	●	●
No. 09	F1b, Male (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●	
		Left (M)	●	●	●	●	○	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 10	F1b, Male (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●	
		Left (M)	○	○	●	●	●	●	●	●	●	●	●	●	○	-	●	●	-	-
No. 11	F1c, Male (LS + RS)	Right (M)	○	○	○	○	-	○	●	●	●	●	●	-	-	-	●	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 12	F1c, Male (LS + RS)	Right (M)	○	○	○	○	○	○	○	-	○	-	○	-	-	●	●	●	●	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●	
No. 13	F1c, Male (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●	
		Left (M)	-	-	○	●	●	●	●	●	●	●	●	○	-	●	●	-	●	
No. 14	F1e, Male (LS)	Right (M)	●	-	●	●	●	●	●	●	●	●	●	-	-	●	●	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
No. 15	F1g, Male (LS + RS)	Right (M)	○	○	○	○	○	○	●	○	-	-	-	-	-	●	●	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
No. 01	F1a, Female (LS)	Right (M)	●	●	●	●	-	-	-	-	-	-	-	●	-	●	-	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 02	F1a, Female (RS)	Right (M)	●	○	○	○	○	○	○	○	○	○	○	○	●	-	○	○	-	-
		Left (M)	●	○	○	○	○	○	○	○	○	○	○	○	○	●	-	○	○	-
No. 03	F1a, Female (LS + RS)	Right (M)	●	○	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
		Left (M)	●	-	○	○	●	●	●	●	●	●	●	●	●	●	-	●	●	-
No. 04	F1b, Female (LS)	Right (M)	●	-	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
		Left (M)	●	-	●	●	●	●	●	●	●	●	●	●	-	-	●	●	-	-
No. 05	F1b, Female (LS)	Right (M)	●	●	●	●	●	●	-	-	●	-	-	●	-	●	-	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 06	F1b, Female (RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
		Left (M)	●	●	●	●	○	○	○	○	○	○	○	○	○	-	●	●	-	●
No. 07	F1b, Female (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●	
		Left (M)	○	○	○	○	-	●	●	-	-	-	-	○	-	○	-	-	-	-
No. 08	F1e, Female (LS + RS)	Right (M)	●	○	○	○	○	○	-	○	○	○	○	○	-	○	○	-	-	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 09	F1f, Female (LS)	Right (M)	●	●	●	●	●	●	-	-	-	-	-	●	-	●	-	-	●	
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 10	F1f, Female (RS)	Right (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-
		Left	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 11	F1g, Female (LS + RS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	-	-	
		Left (M)	●	-	-	●	●	●	●	●	●	●	●	●	-	-	-	●	-	-

Note: See explanations in Supplementary Tables 9 and 14.

**Supplementary Table 17 | Presence or absence of the spots that belong to the first and second spot arrays in the F<sub>2</sub>-generation individuals.**

Male/Female (LS/RS)	Wing side	1st spot array									2nd spot array								
		1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9
No. 01 F2a, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left (M)	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●
No. 02 F2a, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Left (M)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
No. 03 F2d, Male (LS)	Right (M)	-	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	-	●
	Left (M)	-	●	●	●	●	●	●	●	-	●	●	●	●	●	●	●	●	●
No. 01 F2a, Female (RS)	Right (M)	-	●	●	●	●	●	○	○	-	-	●	●	●	○	○	○	○	-
	Left (M)	●	●	●	●	●	●	●	●	-	●	●	●	○	●	●	○	○	-
No. 02 F2d, Female (LS + RS)	Right (M)	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	○	-	-
	Left (M)	●	●	●	●	●	●	○	-	-	●	●	●	●	●	●	○	-	-

Note: See explanations in Supplementary Tables 9 and 13.

**Supplementary Table 18 | Presence or absence of the spots that belong to the third and fourth spot arrays in the F<sub>2</sub>-generation individuals.**

Male/Female (LS/RS)	Wing side	3rd spot array									4th spot array					
		3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	4-1	4-2	4-3	4-4	4-5	4-6
No. 01 F2a, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left (M)	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
No. 02 F2a, Male (LS)	Right	●	●	●	●	●	●	●	●	●	●	-	●	●	-	●
	Left (M)	●	-	●	●	●	●	●	●	●	●	-	●	●	-	●
No. 03 F2d, Male (LS)	Right (M)	-	-	●	●	●	-	-	-	●	-	-	●	-	-	●
	Left (M)	-	-	●	●	●	-	-	-	●	-	-	●	-	-	●
No. 01 F2a, Female (RS)	Right (M)	●	●	○	○	○	○	●	●	●	●	-	●	●	-	●
	Left (M)	●	●	●	○	●	●	●	●	●	●	-	●	●	-	●
No. 02 F2d, Female (LS + RS)	Right (M)	●	●	●	●	●	●	●	-	●	●	-	●	●	-	-
	Left (M)	●	●	●	●	●	○	●	-	-	●	-	●	-	-	-

Note: See explanations in Supplementary Tables 9 and 14.



**Supplementary Table 19 | Percentages of the loss-of-spot individuals that belong to the first and second arrays in the normal and mutant groups.**

Groups examined ( <i>n</i> )	Wing side	Loss-of-spot individuals (%)																	
		1st spot array									2nd spot array								
		1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9
Normal type ( <i>n</i> = 50)	Right	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
	Left	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
P generation ( <i>n</i> = 7)	Right	0.0	0.0	0.0	0.0	0.0	0.0	28.6	28.6	85.7	0.0	0.0	0.0	0.0	0.0	0.0	28.6	42.9	71.4
	Left	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	100	0.0	0.0	0.0	0.0	0.0	0.0	14.3	28.6	100
F1 generation ( <i>n</i> = 26)	Right	7.7	3.9	0.0	0.0	0.0	0.0	3.9	7.7	73.1	0.0	3.9	0.0	0.0	0.0	0.0	0.0	3.9	38.5
	Left	11.5	3.9	0.0	0.0	0.0	0.0	0.0	3.9	76.9	0.0	3.9	0.0	0.0	0.0	0.0	0.0	3.9	23.1
F2 generation ( <i>n</i> = 5)	Right	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	80.0	0.0	0.0	0.0	0.0	0.0	40.0	40.0	40.0
	Left	20.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	60.0	60.0	0.0	20.0	0.0	0.0	0.0	40.0	20.0	40.0

Note: Percentages of the loss-of-spot (LS) individuals were calculated by dividing the number of individuals with spot loss by the total number of individuals, and multiplied by a hundred. This table summarises Supplementary Tables 9, 10, 13, 15, and 17.

**Supplementary Table 20 | Percentages of the loss-of-spot individuals that belong to the third and fourth arrays in the normal and mutant groups.**

Groups examined ( <i>n</i> )	Wing side	Loss-of-spot individuals (%)														
		3rd spot array							4th spot array							
		3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	4-1	4-2	4-3	4-4	4-5	4-6
Normal type ( <i>n</i> = 50)	Right	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	96.0	18.0
	Left	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	96.0	18.0
P generation ( <i>n</i> = 7)	Right	0.0	0.0	0.0	0.0	57.1	0.0	28.6	57.1	0.0	0.0	100	14.3	0.0	100	85.7
	Left	0.0	0.0	0.0	0.0	28.6	0.0	42.9	57.4	0.0	0.0	100	0.0	0.0	100	71.4
F1 generation ( <i>n</i> = 26)	Right	7.7	19.2	7.7	7.7	15.4	7.7	19.2	23.1	19.2	30.8	100	7.7	15.4	88.5	65.4
	Left	7.7	23.1	11.5	7.7	7.7	11.5	7.7	15.4	11.5	15.4	96.2	3.9	11.5	76.9	53.9
F2 generation ( <i>n</i> = 5)	Right	20.0	20.0	0.0	0.0	0.0	20.0	20.0	40.0	20.0	20.0	100	0.0	20.0	100	20.0
	Left	20.0	40.0	0.0	0.0	0.0	20.0	20.0	40.0	40.0	20.0	100	0.0	40.0	80.0	20.0

Note: See explanations in Supplementary Table 19. This table summarises Supplementary Tables 11, 12, 14, 16, and 18.