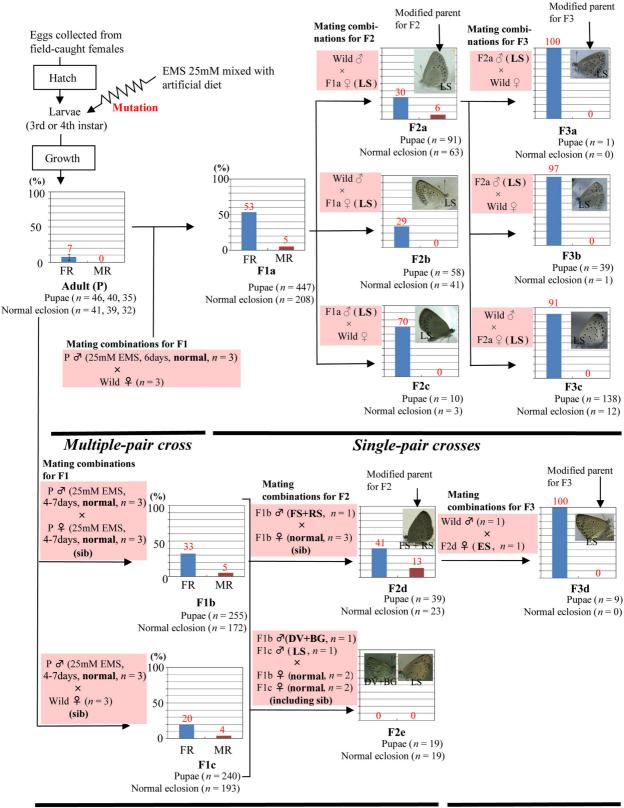
SUPPLEMENTARY INFORMATION

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

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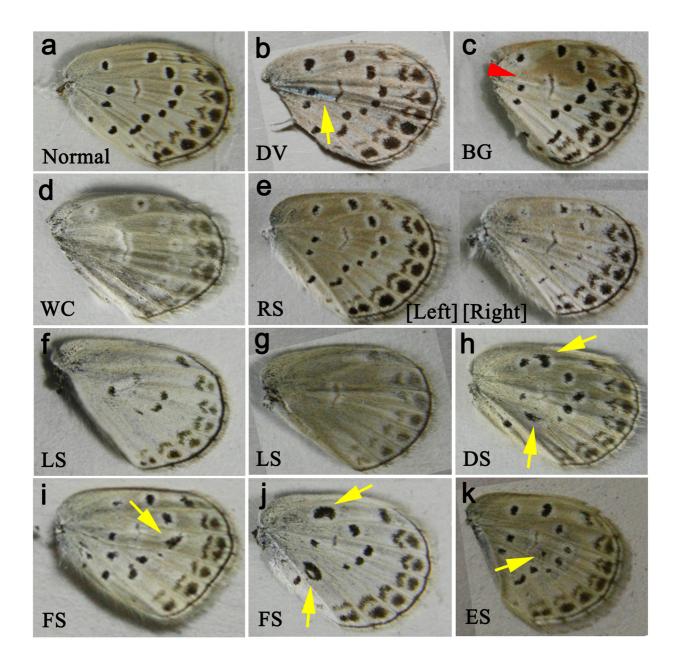
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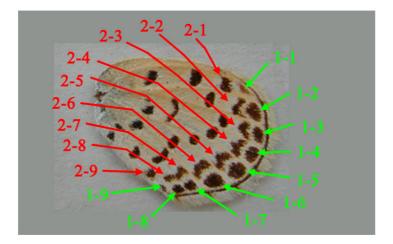
Multiple-pair crosses

Single-pair cross

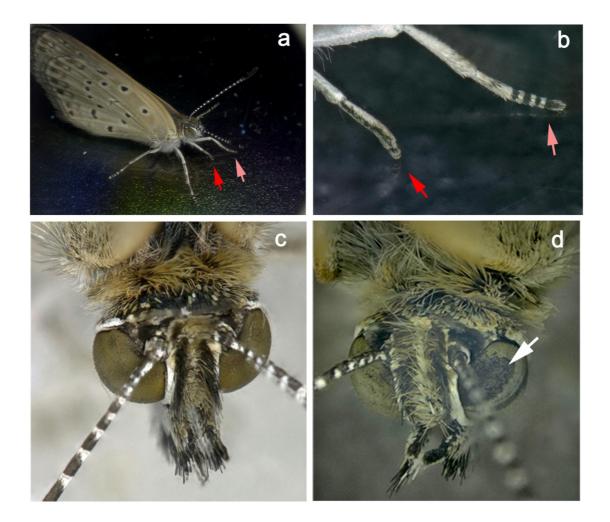
Supplementary Figure 1 | Crosses performed in this study and their results. The parents used for a cross are shown in a pink box. Also see Supplementary Tables 1-8. The failure rate (FR) and the modification rate (MR) are shown together with the number of individuals that were obtained at the bottom of each bar graph. The offspring of each cross are named F_{1a} , F_{1b} , 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_1 mutants. (a, b) Aberrant foreleg tips of a female F_1 a 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_1 f mutant. Normal eyes are shown in c. Aberrant eye mosaicism is indicated by a white arrow in d.

Generation (ND or AD)	Parents of this generation	Pupae (<i>n</i>)	Normal eclosion (<i>n</i>)	FR (%)	MR (%)	Panda type with non- deformed wings (<i>n</i>)	Panda type with deformed wings (n)	Crescent type with non- deformed wings (<i>n</i>)	Crescent type with deformed wings (<i>n</i>)	Wing-size asymmetry (<i>n</i>)
< Experime	ent 1 > Nat	tural diet	: (host plar	nt), siblir	ng crosse	es, founding pa	arents caugh	nt in Okinawa Is	sland	
P(ND)	FC	69	51	26.1	0.0	0	0	0	0	0
$F_1(ND)$	P(ND)	71	70	1.5	0.0	0	0	0	0	0
$F_2(ND)$	$F_1(ND)$	288	236	18.1	0.0	0	0	1	0	0
F ₃ (ND)	F ₂ (ND)	122	42	65.6	0.0	10	12	1	0	1
< Experime	ent $2 > Nat$	tural diet	(host plar	t), non-s	sibling c	rosses, foundi	ng parents c	aught in Kobe	(Hyogo Pret	fecture)
P(ND)	FC	125	114	9.7	0.0	0	0	0	0	0
$F_1(ND)$	P(ND)	277	254	8.3	0.0	0	0	0	0	0
< Experime	ent $3 > Nat$	tural or a	rtificial di	et, non-s	ibling cr	osses, foundi	ng parents c	aught in Okina	wa 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
$F_1(ND)$	P(AD)	10	10	0.0	0.0	0	0	0	0	0
$F_1(AD)$	P(AD)	37	30	18.9	0.0	0	0	0	0	0

Supplementary Table 1 | Rearing experiments without EMS treatment.

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

Cross ID	Normal	Summary of al	Aberrant	Aberrant	PTN	PTD	CTN	CTD	
Cross ID	eclosion (<i>n</i>)	modifications (n) [%]	Aberrant legs (n) [%]	Aberrant eyes (n) [%]	PTN (<i>n</i>) [%]	PTD (<i>n</i>)	(<i>n</i>) [%]	(<i>n</i>)	Wing-size asymmetry (<i>n</i>) [%]
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 ₁ a	208	10 [4.8%]	1 [0.5%]	0 [0%]	0 [0%]	0	0 [0%]	0	12 [5.8%]
F ₁ b	172	8 [4.7%]	0 [0%]	0 [0%]	0 [0%]	1	1	0	10 [5.8%]
F ₁ c	193	7 [3.6%]	1[0.5%]	0 [0%]	0 [0%]	0	[0.6%] 0 [0%]	0	6 [3.1%]
F ₁ d	103	1 [1.0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [1.0%]
F ₁ e	176	4 [2.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	4 [2.3%]
F_1f	34	2 [5.9%]	0 [0%]	1 [2.9%]	0 [0%]	0	0 [0%]	0	0 [0%]
F ₁ g	9	3 [33.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	2 [22.2%]
F ₂ a	63	4 [6.3%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [1.6%]
F ₂ b	41	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	3 [7.3%]
F ₂ c	3	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F ₂ d	23	3 [13.0%]	0 [0%]	0 [0%]	0 [0%]	0	1 [4.3%]	0	0 [0%]
F ₂ e	19	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	1 [5.3%]
F ₃ a	1	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F ₃ b	0	0 [0%]	0 [0%]	0 [0%]	0 [0%]	0	0 [0%]	0	0 [0%]
F ₃ c	12	0 [0%]	0 [0%]	0 [0%]	1	0	1	0	0 [0%]
F ₃ d	0	0 [0%]	0 [0%]	0 [0%]	[8.3%] 0 [0%]	1	[8.3%] 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
Total	1	11

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

Supplementary Table 4 | Mating combinations of parents to obtain the F₁ 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>)	FR (%)	MR (%)
F ₁ a	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 ₁ b	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 ₁ c	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 ₁ d	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 ₁ e	P males reared with 25 mM EMS for 5 days P females reared with 25 mM EMS for 6 days	්3 ද3	285	176	4	38.3	2.3
F_1f	P males reared with 50 mM EMS for 4-6 days Wid-type females reared with natural diet (host plant)	♂3 ♀3	49	34	2	30.6	5.9
F ₁ g	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
Total			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.

Modification types	F_1a	F_1b	F_1c	F_1d	F_1e	F_1f	F_1g	F ₂ a	F_2d	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
Total	15	14	11	1	5	3	7	5	4	65

Supplementary Table 5 | Modification types of the F1 and F2 mutants.

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

Supplementary Table 6 | Crosses of the P adults to obtain the F_1 mutants.

Male and female adults for cross	Trials (n)	Success (n)	Failure (<i>n</i>)	Success rate (%)	Progeny (Mutant lines)
P \bigcirc reared with artificial diet (<i>n</i> = 4) P \bigcirc reared with artificial diet (<i>n</i> = 2)	1	1	0	100	NA
P \bigcirc reared with 25 mM EMS (<i>n</i> = 3) Wild $♀$ (n = 3)	3	3	0	100	F_1a, F_1c, F_1d
P \bigcirc reared with 25 mM EMS ($n = 3$) P \bigcirc reared with 25 mM EMS ($n = 3$)	2	2	0	100	F_1b, F_1e
P \bigcirc reared with 50 mM EMS (<i>n</i> = 3) Wild $♀$ (<i>n</i> = 3)	2	2	0	100	F_1f , F_1g
P \bigcirc reared with 100 mM EMS (<i>n</i> = 3) Wild $♀$ (<i>n</i> = 3)	1	0	1	0	NA
P \bigcirc reared with 100 mM EMS ($n = 2$) P \bigcirc reared with 100 mM EMS ($n = 2$)	1	0	1	0	NA
Total	10	8	2	80	

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

Male and female adults for cross	Trials (<i>n</i>)	Success (<i>n</i>)	Failure (<i>n</i>)	Success rate (%)	Progeny (Mutant lines)
F ₁ a \mathcal{J} modified (<i>n</i> = 1) Wild \mathcal{Q} (<i>n</i> = 1)	2	1	1	50	F ₂ c
Wild $\stackrel{\wedge}{\bigcirc} (n = 1)$ F ₁ a $\stackrel{\bigcirc}{\hookrightarrow}$ modified $(n = 1)$	2	2	0	100	F_2a , F_2b
F_1b ♂ modified (<i>n</i> = 1) F_1b ♀ non-modified (<i>n</i> = 4)	2	1	1	50	F ₂ d
$F_1c \stackrel{\wedge}{\to} \text{modified } (n = 1)$ $F_1c \stackrel{\wedge}{\to} \text{non-modified } (n = 1)$	1	0	1	0	NA
F ₁ b ♂ modified ($n = 1$), F ₁ c ♂ modified ($n = 1$) F ₁ b ♀ non-modified ($n = 2$), F ₁ c ♀ non-modified ($n = 2$)	1	1	0	100	F ₂ e
$F_1 f rightharpoonup modified (n = 1)$ Wild $Q (n = 1)$	1	0	1	0	NA
Total	9	5	4	56	

Supplementary Table 7 | Crosses of the F₁ adults to obtain the F₂ mutants.

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

Male and female adults for cross	Trials (<i>n</i>)	Success (n)	Failure (<i>n</i>)	Success rate (%)	Progeny (Mutant lines)
Wild $\circlearrowleft (n = 1)$ F ₂ a \hookrightarrow modified (n = 1)	1	1	0	100	F ₃ c
F ₂ a $\stackrel{\frown}{\bigcirc}$ modified (<i>n</i> = 1) Wild $\stackrel{\bigcirc}{\ominus}$ (<i>n</i> = 1)	3	2	1	33	F ₃ a, F ₃ b
F ₂ a $ \bigcirc $ non-modified (<i>n</i> = 4) F ₂ a $ \bigcirc $ non-modified (<i>n</i> = 4)	2	0	2	0	NA
F ₂ b \bigcirc non-modified (<i>n</i> = 4) F ₂ b \bigcirc non-modified (<i>n</i> = 4)	1	0	1	0	NA
Wild $\circlearrowleft (n = 1)$ F ₂ d \hookrightarrow modified (n = 1)	2	1	1	50	F ₃ d
F ₂ d \circlearrowleft modified (<i>n</i> = 1) Wild $\stackrel{\frown}{+}$ (<i>n</i> = 1)	1	0	1	0	NA
F_2d ♂ non-modified (<i>n</i> = 1) Wild ♀ (<i>n</i> = 1)	2	0	2	0	NA
Total	12	4	8	33	

Supplementary Table 8 | Crosses of the F₂ adults to obtain the F₃ mutants.

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 ar	ray								l spot a	rray			
		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	•	•	•	•	•	٠	•	•	-	•	•	•	•	•	•	•	•	•
No. 04	Right wing	•	٠	•	•	٠	٠	•	٠	•	•	•	•	٠	•	٠	•	•	٠
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠
No. 05	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
No. 06	Right wing	•	٠	•	•	٠	٠	•	٠	•	•	٠	•	٠	٠	٠	•	•	٠
	Left wing	•	٠	٠	•	٠	۲	٠	٠	•	•	٠	٠	٠	٠	٠	•	•	۲
No. 07	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
No. 08	Right wing	٠	٠	•	٠	٠	٠	•	•	•	•	•	•	٠	٠	•	•	٠	٠
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠
No. 09	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
No. 10	Right wing	•	٠	•	•	٠	٠	•	٠	•	•	•	٠	٠	•	٠	•	•	٠
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠
No. 11	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
No. 12	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	-	•	٠	٠	٠	٠	٠	٠	٠	٠
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
No. 13	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
No. 14	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	-	•	٠	٠	٠	٠	٠	٠	٠	٠
	Left wing	•	•	•	•	•	٠	•	•	-	•	•	•	•	•	•	•	•	٠
No. 15	Right wing	•	•	•	•	•	•	•	•	_	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	_	•	•	•	•	•	•	•	•	•
No. 16	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
110.10	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
No. 17	Right wing	•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•
10.17	Left wing	•		•		•		•	•	•		•	•	•	•	•	•		•
No. 18	Right wing	•				•	•	•	•	•	•	•		•	•	•			•
110.10	Left wing	•		•	•		•	•	•	•	•	•	•	•	•	•	•	•	•
No. 19	Right wing	•		•					•	•					•	•		•	
10.19	Left wing					-	-												
No. 20	Right wing									•									
NO. 20	Left wing	•								-			•						
No. 21				-	-	-	-			-			-	•	-			-	•
No. 21	Right wing Left wing	•	-	•		•		•	•		•	•	•	-	•		•	•	•
No. 22		•	-	•	•	•		•	•	-		•	•	•	•		•	-	-
No. 22	Right wing	•	-	•	•	•	•		•	•	•		-	-	•	•	-	•	-
N- 22	Left wing	•	•	-	•	•	•	-	•	•	•	•	•	•	-	•	•	•	•
No. 23	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
No. 24	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
NY 05	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
No. 25	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: Black dots (\bullet) 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 10 Presence or absence of the spots t arrays in the normal-type female individuals.	that belong to the first and second spot
lst enot array	2nd spot array

Famala No	Wing side				1st	spot a	rray							2nc	l spot a	array			
Female No.	wing side	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
No. 01	Right wing	•	٠	٠	٠	•	•	٠	•	•	•	•	•	•	٠	•	•	•	
	Left wing	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	•	•	•	
No. 02	Right wing	٠	٠	٠	٠	٠	٠	۲	٠	•	•	٠	٠	٠	٠	٠	٠	•	
	Left wing	٠	٠	٠	٠	٠	٠	٠	٠	•	•	•	•	•	٠	•	•	•	
No. 03	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	٠	•	٠	•	•	٠	•	•	•	•	•	•	•	•	•	•	
No. 04	Right wing	٠	۲	٠	٠	٠	٠	۲	٠	•	•	٠	٠	٠	۲	٠	٠	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
No. 05	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
No. 06	Right wing	٠	٠	٠	٠	•	•	•	•	•	•	٠	٠	٠	٠	٠	٠	٠	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
No. 07	Right wing	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
lo. 08	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	-	•	٠	٠	٠	٠	٠	٠	٠	
	Left wing	•	٠	٠	٠	•	٠	٠	•	-	•	٠	٠	٠	٠	•	٠	٠	
lo. 09	Right wing	•	٠	•	٠	•	•	•	٠	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
lo. 10	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	•	٠	٠	٠	٠	٠	٠	٠	٠	
	Left wing	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
lo. 11	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
Jo. 12	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	•	٠	٠	٠	٠	٠	٠	٠	٠	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Jo. 13	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
No. 14	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	•	•	٠	٠	٠	٠	٠	٠	٠	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
No. 15	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Jo. 16	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	•	•	٠	٠	٠	٠	٠	٠	٠	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Jo. 17	Right wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
lo. 18	Right wing	٠	٠	٠	٠	٠	٠	٠	٠	-	•	•	•	٠	٠	•	٠	٠	
	Left wing	•	٠	•	٠	•	٠	•	٠	-	•	•	•	•	•	•	•	•	
lo. 19	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
lo. 20	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Jo. 21	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
lo. 22	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Jo. 23	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	
Jo. 24	Right wing	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Left wing	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•	
Jo. 25	Right wing				•											-			
10.23	Left wing	-		-		-		-	-			-	-	-		-	-		

Note: See explanations in Supplementary Table 9.

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				3r	d spot ar	ray							ot 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	٠	٠	•	•	٠	•	•	٠	•	٠	-	•	•	٠	•
No. 03	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
No. 04	Right wing	•	•	•	•	•	•	•	٠	•	•	-	•	•	•	•
	Left wing	•	•	•	•	٠	•	•	•	•	•	-	•	•	•	•
No. 05	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
No. 06	Right wing	•	•	٠	•	•	•	•	٠	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 07	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 08	Right wing	٠	•	•	٠	٠	•	٠	٠	•	•	-	•	٠	-	-
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	-
No. 09	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.07	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 10	Right wing		•			•	•	•	•	•	•	-	•	•	-	-
10.10	Left wing	•	•	•		•	•	•	•	•	•	-	•	•	_	-
No. 11	Right wing				•				•	•		-	•		_	_
NO. 11	Left wing	-		•				•	•				•			
No. 12				•	•	•		•	•	•		-	•	•	_	
NO. 12	Right wing							•		•					-	
NL 12	Left wing	•	•	•	-	•	•	•	-	-	•	-	•	•	-	•
No. 13	Right wing	•		•	•		•	•	•	•	•	-	•	•	-	•
N7 14	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 14	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 15	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
No. 16	Right wing	•	•	•	•	•	•	•	٠	•	•	-	•	•	-	•
	Left wing	•	•	•	•	٠	•	٠	٠	•	٠	-	•	•	-	•
No. 17	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 18	Right wing	•	•	•	•	•	•	•	٠	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 19	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 20	Right wing	٠	٠	•	•	٠	•	٠	٠	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	٠	•	•	-	•	•	-	•
No. 21	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 22	Right wing	٠	•	٠	٠	٠	•	٠	٠	•	•	-	٠	٠	-	٠
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 23	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 24	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•			•	•	-	•	•	_	•
No. 25	Right wing		•					•	•	•		-		•	_	-
110.25	Left wing	•				•	-	-						•		

Note: Black dots (\bullet) 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 12 | Presence or absence of the spots that belong to the third and fourth spot arrays in the normal-type female individuals.

Female No.	Wing side	2.1		2.2		d spot ar			2.0	2.0	<u> </u>		4th spo			
No. 01		<u>3-1</u>	3-2	3-3 •	<u>3-4</u>	3-5	3-6	3-7 •	3-8	<u>3-9</u>	4-1	4-2	4-3 •	4-4	4-5	4-6
NO. 01	Right wing Left wing	•			•	-			•		•	-	•		-	
No. 02	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.02	Left wing	•	•	•	•	•	•	•	•	•	•	_	•	•	_	•
No. 03	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	•
110.05	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	•
No. 04	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.01	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 05	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.00	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 06	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	Left wing	•	•	•	•	•	•	•	•	•	•	_	•	•	-	•
No. 07	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
10.07	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 08	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.00	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 09	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	•
110.07	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 10	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.10	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 11	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	_
No. 12	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	٠
110.12	Left wing	•	•	•	•	•	•	•	•	•	•	_	•	•	_	•
No. 13	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.15	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 14	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.11	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 15	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	•
110.10	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 16	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
1101 10	Left wing	•	•	•	•	•	•	•	•	•	•	_	•	•	-	•
No. 17	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	_	-
110.17	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
No. 18	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
1101 10	Left wing	•	•	•	•	•	•	•	•	•	•	_	•	•	-	•
No. 19	Right wing	•	•	•	•	•	•	•	•	•	•	_	•	•	_	_
110.17	Left wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
No. 20	Right wing	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
110.20	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: See explanations in Supplementary Tables 9 and 11.

Ma	le/Female	Wing side				1	st spot ar	ry							2r	nd spot a	rray			
(.	LS/RS)	wing side	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	Right (M)	•	•	•	•	•	٠	-	-	-	•	•	•	٠	•	•	-	-	-
	(LS)	Left (M)	•	•	•	•	•	•	-	-	-	•	•	•	•	•	•	-	-	-
No. 02	P, Male	Right (M)	٠	٠	۲	٠	٠	٠	٠	٠	-	•	٠	٠	٠	٠	٠	٠	•	-
	(LS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	٠	•	•	•	-
No.01	P, Female	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•		-
	(LS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
No.02	P, Female	Right (M)	٠	٠	۲	٠	٠	٠	-	-	-	•	٠	٠	٠	٠	٠	٠	٠	•
	(LS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	٠	•	•	•	-
No.03	P, Female	Right (M)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	(LS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
No.04	P, Female	Right (M)	•	٠	•	•	•	٠	٠	٠	-	٠	٠	•	٠	٠	•	-	-	-
	(LS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	-
No.05	P, Female	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	-	-
	(LS+RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	-	-

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.

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.

М	ale/Female	Wing				3rd	spot array							4th sp	ot array		
	(LS/RS)	side	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	Right (M)	•	•	•	•	•	٠	•	•	•	•	-	•	٠	-	•
	(LS)	Left (M)	•	•	•	•		•	•	•	•	•	-	•	•	-	•
No. 02	P, Male	Right (M)	•	٠	٠	•	•	٠	-	-	•	•	-	•	٠	-	-
	(LS)	Left (M)	•	•	•	٠	•	•	-	-	•	•	-	•	•	-	-
No.01	P, Female	Right (M)	•	•	•	٠	-	•	•	-	•	•	-	•	•	-	-
	(LS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
No. 02	P, Female	Right (M)	•	٠	٠	•	-	٠	٠	٠	•	•	-	•	٠	-	-
	(LS)	Left	•	•	•	•	•	٠	٠	•	•	•	-	•	٠	-	-
No.03	P, Female	Right (M)	•	•	•	•	•	•	-	-	•	•	-	-	•	-	-
	(LS)	Left (M)	•	•	•	•	-	•	-	-	•	•	-	•	•	-	-
No.04	P, Female	Right (M)	•	•	•	•	-	•	٠	-	•	•	-	•	•	-	-
	(LS)	Left (M)	•	•	•	•	•	•	•	-	•	•	-	•	•	-	-
No.05	P, Female	Right (M)	•	•	•	•	-	•	0	0	•	•	-	•	•	-	-
	(LS + RS)	Left (M)	•	•	•	•	0	•	-	-	•	•	-	•	•	-	-

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.

	ale/Female	Wing side				1st	spot arry								2nd sp	ot arra	y			
	(LS/RS)	wing side	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
lo. 01	F1a, Male	Right (M)	٠	•	•	•	•	•	-	-	-	•	•	٠	•	٠	٠	•	•	
	(LS)	Left (M)	-	-	•	•	•	•	•	-	-	•	•	٠	•	•	٠	•	•	
o. 02	F1a, Male	Right	٠	•	•	•	•	٠	٠	٠	-	•	٠	٠	٠	٠	٠	٠	٠	
	(RS)	Left (M)	-	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
o. 03	F1a, Male	Right	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	(LS + RS)	Left (M)	-	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
o. 04	F1a, Male	Right (M)	-	•	•	•	•	•	•	-	-	•	•	•	•	•	٠	•	•	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	_	•	•	•	•	•	•	•	•	
0. 05	F1a, Male	Right (M)	•	•	•	•	•	•	-		_	•	•			•	•		•	
0.05	(LS + RS)		•			-			-	-					-	-	-	-	-	
06		Left (M)									-			•		•				
0. 06	F1a, Male	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	(LS + RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	_
. 07	F1b, Male	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	(LS)	Left (M)	•	•	•	•	•	•	•	•	-	•	-	•	•	•	•	•	•	
. 08	F1b, Male	Right	٠	•	•	•	•	•	•	•	•	•	•	٠	•	٠	٠	•	•	
	(LS)	Left (M)	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	
o. 09	F1b, Male	Right	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	(RS)	Left (M)	•	•	•	•	•	•	•	•		•	•	•	•	•	٠	•	•	
o. 10	F1b, Male	Right	٠	•	•	•	•	•	•	٠	•	•	•	٠	٠	٠	٠	٠	•	
	(RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	٠	•	•	•	
. 11	F1c, Male	Right (M)	-	0	•	0	0	0	•	•	-	0	0	0	0	0	0	•	-	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
. 12	F1c, Male	Right (M)	٠	•	•	•	•	٠	•	•	-	•	•	٠	٠	٠	٠	٠	•	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
0. 13	F1c, Male	Right	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
. 15	(LS + RS)	Left (M)	•	•	•	•	•	•		•	•	•	•					•		
o. 14	F1e, Male		•	•	•	•					-		•							
). 14		Right (M)		•	-	•	•				-		•							
1.5	(LS)	Left	•	-	•	•	•	•	•	•	•	•	-	•	•	•	-	•	•	
o. 15	F1g, Male	Right (M)	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
0. 01	F1a, Female	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	(LS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
o. 02	F1a, Female	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	0	0	
	(RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	0	0	
0.03	F1a, Female	Right (M)	•	•	•	•	٠	•	•	٠	-	•	٠	٠	•	٠	٠	٠	•	
	(LS + RS)	Left (M)	•	٠	•	•	•	•	•	٠	-	•	•	٠	•	٠	•	•	•	
0.04	F1b, Female	Right (M)	•	-	•	•	•	•	•	•	-	•	-	•	•	•	•	•	•	
	(LS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
0.05	F1b, Female	Right (M)	٠	٠	٠	•	•	•	٠	٠	-	•	•	•	•	٠	٠	٠	•	
	(LS)	Left	•	٠	•	•	•	•	•	•	-	•	•	•	•	٠	٠	•	•	
. 06	F1b, Female	Right	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
	(RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
0. 07	F1b, Female	Right	•	•	•	•	•	•	٠	•	•	•	•	•	•	٠	٠	•	•	
	(LS + RS)	Left (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
. 08	F1e, Female	Right (M)	•	•	•	•	•	•	•	•	_	•	•	•	•	•	•	•	•	
. 00	(LS + RS)	Left	•			•	•				•						-			
00			-	-	-	•	•	-	-	-	-			-		-	-	-		
0. 09	F1f, Female	Right (M)	-	-	•		•	-	-	-	-	•	-	-	•	-	-	-	-	
1.0	(LS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
o. 10	F1f, Female	Right (M)	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	
	(RS)	Left	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	
o. 11	F1g, Female	Right	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	٠	•	•	
	(LS + RS)	Left (M)	۲	0	0	•	•	•	٠	٠	-	•	0	0	•	•	٠	•	-	

Supplementary Table 15 | Presence or absence of the spots that belong to the first and second spot arrays in the F_1 -generation individuals.

Note: See explanations in Supplementary Tables 9 and 13.

Ma	le/Female (LS/RS)	Wing side				3rd	spot a	rray						4th spo	ot array	/	
Ivia	ie/Telliale (E5/R5)	wing side	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-
No. 01	F1a, Male	Right (M)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(LS)	Left (M)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No. 02	F1a, Male	Right	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
	(RS)	Left (M)	0	0	0	•	•	•	•	0	•	•	-	•	•	-	-
No. 03	F1a, Male	Right	•	•	•	•	•	•	•	•	•	•	-	•	•	-	-
	(LS + RS)	Left (M)	0	0	0	0	0	-	0	0	-	0	•	•	-	-	-
No. 04	F1a, Male	Right (M)	•	-	0	•	•	•	•	•	•	-	-	•	•	-	-
	(LS + RS)	Left	•	٠	•	•	•	•	•	•	•	•	-	٠	٠	-	
No. 05	F1a, Male	Right (M)	-	-	-	-	-	0	0	-	-	-	-	0	0	-	
	(LS + RS)	Left (M)	•	0	-	-	0	•	-	-	•	-	-	•	•	-	
No. 06	F1a, Male	Right (M)	•	0	٠	•	•	•	•	•	•	-	-	•	•	-	
	(LS + RS)	Left (M)	٠	-	0	•	•	•	•		•	•	-	•	•	-	
No. 07	F1b, Male	Right (M)	•	•	•	•	•	•	•	•	•	٠	-	•	•	•	
	(LS)	Left (M)	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
No. 08	F1b, Male	Right	•	٠	٠	٠	•	٠	•	•	•	•	-	٠	٠	-	
	(LS)	Left (M)	•	٠	•	٠	•	-	•	•	•	•	-	٠	٠	٠	
No. 09	F1b, Male	Right	•	•	•	•	•	•	•	•	•	•	-	•	•	•	
	(RS)	Left (M)	•	•	•	•	0	•	•	•	•	•	-	•	•	•	(
No. 10	F1b, Male	Right	•	٠	٠	٠	•	٠	•	٠	•	٠	-	٠	٠	-	
	(RS)	Left (M)	0	0	•	•	•	•	•	•	•	0	-	•	•	-	
No. 11	F1c, Male	Right (M)	0	0	0	0	-	0	•	•	•	-	-	-	•	-	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
Jo. 12	F1c, Male	Right (M)	0	0	0	0	0	0	0	-	0	-	-	٠	٠	٠	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
No. 13	F1c, Male	Right	•	•	•	•	•	•	•	•	•	•	-	•	•	-	(
	(LS + RS)	Left (M)	-	-	0	•	•	•	•	•	•	0	-	•	•	-	
No. 14	F1e, Male	Right (M)	•	-	٠	٠	٠	٠	٠	٠	•	-	-	٠	٠	-	
	(LS)	Left	•	٠	•	•	•	•	•	•	•	•	-	•	•	-	
No. 15	F1g, Male	Right (M)	0	0	0	0	0	0	•	0	-	-	-	•	•	-	
	(LS + RS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
No. 01	F1a, Female	Right (M)	•	•	•	•	-	-	-	-	-	•	-	•	-	-	
10.01	(LS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	•	(
No. 02	F1a, Female	Right (M)	•	0	0	0	0	0	0	0	0	•	_	0	0	_	
10. 02	(RS)	Left (M)	•	0	0	0	0	0	0	0	0	•	_	0	0	-	
lo. 03	F1a, Female	Right (M)	•	0	•	•	•	•	•	•	•	•	-	•	•	-	
10.00	(LS + RS)	Left (M)	•	_	0	0	•	•	•	•	•	•	-	•	•	_	
No. 04	F1b, Female	Right (M)	•	_	•	•	•	•	•	•	•	•	_	•	•	-	
10.01	(LS)	Left (M)	•	-	•	•	•	•	•	•	•	_	-	•	•	-	
No. 05	F1b, Female	Right (M)	•	•	•	•	•	•	-	-	•	•	-	•	-	-	
10.00	(LS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	_	
No. 06	F1b, Female	Right	-	•	•	•	•	•	•	•	•	•	_	•	•	_	
0.00	(RS)	Left (M)		•	•	•	0	0	0	•	•	0		•		•	
lo. 07	F1b, Female	Right	•	•	•	•	•	•	•	•	•	•	-	•		-	
NO. 07	(LS + RS)	Left (M)	0	0	0	0	-	•	•	-	-	0	_	0	•		
Ia 09				0	0				•				-		-	_	
lo. 08	F1e, Female $(\mathbf{I} \mathbf{S} + \mathbf{P} \mathbf{S})$	Right (M)	-			0	0	0		0	•	0		0	0		
Ia 00	(LS + RS)	Left Bight (M)	-	-	-		-	-	•			-	-	-	•	-	
lo. 09	F1f, Female	Right (M)	•	•	-	•	-	•	-	-	-	•	-	-	-	-	
I- 10	(LS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	•	
lo. 10	F1f, Female	Right (M)	•	•	•	•	•	•	•	•	•	•	-	•	•	-	
• • •	(RS)	Left	•	•	•	•	•	•	•	•	•	•	-	•	•	•	
No. 11	F1g, Female	Right	•	٠	٠	۲	•	•	•	•	•	•	-	•	•	-	
	(LS + RS)	Left (M)	•	-	-	•	•	•	•	•	•	-	-	-	•	-	

Supplementary Table 16 | Presence or absence of the spots that belong to the third and fourth spot arrays in the F_1 -generation individuals.

Note: See explanations in Supplementary Tables 9 and 14.

Ma	ale/Female	Wing side				19	st spot a	irry							2nd	spot ar	ray			
((LS/RS)	wing side	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	Right	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	(LS)	Left (M)	•	•	•	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•
No. 02	F2a, Male	Right	٠	٠	•	•	•	•	•	•	•	•	٠	٠	•	•	٠	•	•	•
	(LS)	Left (M)	٠	٠	٠	٠	•	٠	٠	•	•	•	•	٠	٠	•	•	•	•	٠
No. 03	F2d, Male	Right (M)	-	•	•	٠	•	•	•	•	-	•	•	•	٠	•	•	•	-	•
	(LS)	Left (M)	-	•	•	•	•	•	•	•	-	•	•	•	•	•	•	•	•	•
No. 01	F2a, Female	Right (M)	-	٠	٠	٠	٠	٠	0	0	-	-	٠	٠	٠	0	0	0	0	-
	(RS)	Left (M)	٠	•	•	•	•	•	•	•	-	•	•	•	0	•	•	0	0	-
No. 02	F2d, Female	Right (M)	•	•	•	•	•	•	•	•	-	•	•	•	•	•	•	0	-	-
	(LS + RS)	Left (M)	•	•	•	•	•	•	0	-	-	•	•	•	•	•	•	0	-	-

Supplementary Table 17 | Presence or absence of the spots that belong to the first and second spot arrays in the F_2 -generation individuals.

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_2 -generation individuals.

Ma	ale/Female	Wing side				3	rd spot	array						4th sp	ot arra	у	
((LS/RS)	wing side	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	Right	•	•	•	•	•	•	•	•	•	•	-	•	•	-	•
	(LS)	Left (M)	•	•	•	•	•	•	•	•	•	•	-	•	•	•	•
No. 02	F2a, Male	Right	•	٠	٠	٠	٠	•	•	•	•	٠	-	٠	٠	-	•
	(LS)	Left (M)	•	-	٠	•	•	٠	•	•	•	•	-	•	•	-	•
No. 03	F2d, Male	Right (M)	-	-	•	•	•	-	-	-	•	-	-	•	-	-	•
	(LS)	Left (M)	-	-	•	•	•	-	-	-	•	-	-	•	-	-	•
No. 01	F2a, Female	Right (M)	٠	٠	0	0	0	0	•	•	•	•	-	•	•	-	٠
	(RS)	Left (M)	•	•	٠	0	•	•	•	•	•	•	-	•	•	-	•
No. 02	F2d, Female	Right (M)	•	•	•	•	•	•	•	-	•	•	-	•	•	-	-
	(LS + RS)	Left (M)	•	•	•	•	•	0	•	-	-	•	-	•	-	-	-

Note: See explanations in Supplementary Tables 9 and 14.

Loss-of-spot individuals (%) Groups Wing 1st spot array 2nd spot array examined (n)side 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 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 (n = 50)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 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 0.028.6 42.9 71.4 (n = 7)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 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 (*n* = 26) 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 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 (n = 5)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

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

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.

	Win						Los	ss-of-spo	ot indivi	iduals (%	5)					
Groups examined (n)	Wing - side -				3rd spo	ot array							4th sp	ot array		
	side	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	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
(n = 50)	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	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
(n = 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	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
(n = 26)	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	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
(n = 5)	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.