

RESYNTHESIS OF THE R-NAVAJO PHENOTYPE IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

R-nj phenotype was restored when the two R-nj components, Sc and Nj, were brought together in the same individual in trans configuration. This complementation has demonstrated that these two components, Sc and Nj, are closely linked independent genes with different functions. The Sc gene is responsible for anthocyanin pigment production in the aleurone tissue, while Nj gene is regulatory in nature controlling the onset, termination or period of Sc gene action.

Key words: R-nj, resynthesis, complementation, maize.

R-Navajo (R-nj), which in combination with other complementary genes, produces a solid anthocyanin pigmented patch in the crown region of the kernel, offers excellent material for studying differential gene action. Mutational and recombinational analyses carried out with R-nj revealed that it represents a complex with two closely linked discrete components [1]. The self-colour (Sc) component is responsible for anthocyanin production and the Navajo (Nj) component regulates the time of onset and termination of pigment synthesis restricting the pigmentation to the crown region of the kernel. The present investigation aims to resynthesize R-nj phenotype bringing together the two components, Sc and Nj, in trans configuration.

MATERIALS AND METHODS

The materials used in this study included self-colour (Sc), isolated as a recombinant from the testcross (R-nj/g r-g x g r-g), and colourless kernels with golden plant colour carrying latently the reciprocal recombinant, navajo (Nj) from the same testcross, in a uniform genetic background of Stock-2. Unlinked factor used to detect pollen contaminants was y conditioning white endosperm.

In the event of intraallele crossing over at the R-nj gene giving rise to two components, Sc and Nj, only one component, Sc, was isolated from the phenotypic classification [1]. The product of the reciprocal event isolating Nj would go undetected and would be included in the

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colourless kernels. Therefore, the isolated Sc exceptions were crossed as Sc/r-g heterozygotes with a large number of colourless individuals with golden plant colour from the testcross in an attempt to bring together the two presumed components, Sc and Nj, in the same individual and test whether they can resynthesize the R-nj phenotype.

RESULTS AND DISCUSSION

The results on resynthesis of the R-nj phenotype are presented in Table 1. A large number of plants raised from colourless seeds were crossed with Sc/r-g heterozygotes and 62 ears were obtained. Navajo phenotype was observed in a number of crosses. When these cases were critically analysed, it was observed that in many cases the same Sc male produced R-nj phenotype in crosses with different colourless individuals. It is highly improbable that all these colourless individuals carried the crossover product Nj from the original R-nj stock. Progeny testing of the Sc individuals, however, showed that these individuals carried R-nj latently and hence might have originated through contamination.

Table 1. Classification of seeds in the ears from the cross between colourless seeds obtained from R-nj/r-g x r-g r-g testcross and Sc/r-g heterozygotes

Ear No.	Self colour	R-nj	Total coloured	Colourless	Total	χ^2 (1:1) ^a
1	116	—	116	102	218	0.89
2	140	—	140	142	282	0.01
3	50	10	60	57	117	0.08
4	91	—	91	95	186	0.08
5	144	—	144	115	259	3.25
6	118	33	151	65	216	34.24**
7	150	—	150	114	264	4.90*
8	65	28	93	54	147	10.35**
9	—	36	36	28	64	1.00
10	51	—	51	51	102	0.00
11	32	—	32	41	73	1.11
12	70	—	70	71	141	0.00
13	—	4	4	9	13	1.92
14	—	88	88	66	154	3.14
15	62	—	62	75	137	0.62
16	43	—	43	43	86	0.00
17	99	—	99	95	194	0.08
18	50	—	50	37	87	1.94
19	145	1	146	119	265	2.75
20	62	—	62	94	156	6.56
21	67	—	67	68	135	0.00
22	67	—	67	49	116	2.79
23	—	36	36	37	73	0.01

Contd.

Table 1. (Contd.)

Ear No.	Self colour	R-nj	Total coloured	Colourless	Total	$\chi^2(1:1)^a$
24	—	33	33	40	73	0.67
25	—	2	2	267	269	261.06**
26	17	—	17	21	38	0.42
27	102	—	102	108	210	0.17
28	94	—	94	78	172	1.49
29	27	—	27	26	53	0.02
30	40	—	40	32	72	0.89
31	100	—	100	80	180	2.22
32	84	—	84	80	164	0.09
33	48	—	48	43	91	0.27
34	131	—	131	33	164	58.56**
35	97	—	97	73	170	3.38
36	56	—	56	71	127	1.77
37	43	4	47	61	108	1.81
38	39	—	39	42	81	0.11
39	660	—	60	74	134	1.46
40	114	—	114	95	209	1.73
41	110	—	110	110	220	0.00
42	56	—	56	64	120	0.53
43	89	—	89	90	179	0.01
44	21	51	72	98	170	3.98*
45	107	—	107	110	217	0.04
46	55	—	55	50	105	0.24
47	148	—	148	182	330	3.50
48	108	—	108	92	200	1.28
49	27	—	27	33	60	0.60
50	100	—	100	90	190	0.53
51	95	—	95	94	189	0.01
52	48	—	48	42	90	0.40
53	92	—	92	96	188	0.09
54	110	—	110	102	212	0.30
55	—	20	20	—	20	—
56	—	22	22	—	22	—
57	—	13	13	—	13	—
58	56	—	56	48	104	0.62
59	16	—	16	15	31	0.03
60	26	—	26	27	53	0.02
61	47	—	47	45	92	0.04
62	14	4	18	10	28	2.29
Total	3999	385	4384	4249	8633	2.11

^a Tested against the 1:1 ratio for coloured vs. colourless.

*, ** Significant at 5% and 1% levels, respectively.

One case, however, was interesting: the self-colour isolate produced self-coloured and colourless kernels in 3:1 ratio on the selfed ear, but produced all R-nj kernels when crossed as male on three different colourless individuals (ears no. 55, 56 and 57). No plausible explanation could be offered for this peculiar behaviour, and it is also highly improbable that all the three colourless individuals carried the Nj component, so that the R-nj phenotype manifested from complementation between Sc and Nj in trans heterozygote.

Normally in the event of such complementation in the cross $Sc/r \times Nj/r$ to synthesize the R-nj phenotype, the expected phenotypes in the crossed ear would be 1/4 self-colour : 1/4 R-nj : 2/4 colourless. Only one such case was identified: the crossed ear no. 44 produced 21 solid colour, 51 R-nj, and 98 colourless kernels. The $Sc/r-g$ plant on selfing produced coloured and colourless seeds only and no R-nj. Hence, it may be taken as a possible case of resynthesis of R-nj phenotype in trans configuration of the two components, Nj and Sc. This complementation suggests that the two components, Sc and Nj, are different closely linked genes having different functions. The Sc gene is responsible for anthocyanin production and Nj regulates the time of onset and termination of pigment synthesis restricting the pigmentation to the crown region of the kernel.

REFERENCE

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