Independent Assortment of seed color and leaf hairiness genes in *Brassica rapa* L.

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ABSTRACT

- Seed color segregated into brown, yellow-brown and yellow that was under digenic control where the brown or yellow-brown color was dominant over yellow seed color.
- Leaf hairiness was found to be under monogenic control and hairy leaf was dominant over non-hairy leaf.
- Genes controlling the seed color and leaf hairiness are inherited independently.

INTRODUCTION

- Yellow-seeded cultivars in Brassica species contained 5-7% more oil , and lower fibre and higher protein in meal over their dark-seeded counterparts (Shirzadegan and Röbellen 1985).
- Leaf hairiness is an important trait that plays a key role in plant protection from abiotic stresses (such as, UV damage, drought tolerance) and from biotic stresses (such as, insect infestation, disease infection) (Skaltsa et al., 1994; Ågren and Schemske 1992).

MATERIALS AND METHODS

- The brown seeded, leaf hairiness *B. rapa* subsp. *chinensis* line was obtained from the U.S. National Plant Germplasm System (Accession PI-633165) and the yellow seeded cultivar (BARI-6) was obtained from Bangladesh Institute of Nuclear Agricultural.
- The parents, F_1, F'_1, F_2, F_3 and BC_1 were grown and studied in a greenhouse at North Dakota State University, Fargo, ND, USA.

RESULTS AND DISCUSSIONS

Seed coat color inheritance in *B. rapa*

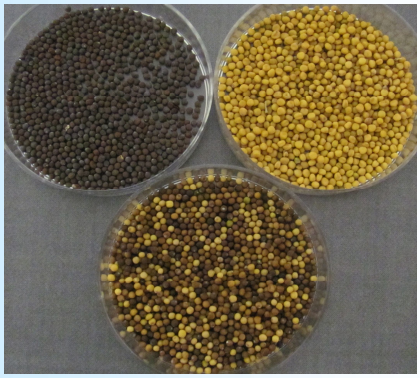
- A pollen effect was found when the yellow seeded parent was used as the female parent so the F_1 seeds were dark yellow instead of yellow (Fig. 1).
- The seed color segregated with dominant epistatic 12:3:1 ratio in the F_2 and 2:1:1 in the BC_1 for brown, yellow-brown and yellow (Fig. 2, Table 1) confirming a digenic inheritance with dominant epistatic nature of brown color, hypostatic nature of yellow-brown color, and recessive nature of yellow color..

Fig 1: The F_1 seed

Table 1: Segregation of seed color in the F_2 and BC_1 populations of *B. rapa* crosses

Populations	Total plants	Brown	Yellow-brown	Yellow	Segregation ratio tested			
					12 : 3 : 1		15 : 1	
					χ^2	P	χ^2	P
F_2 populations								
PI-633165 x BARI-6	72	53	14	5	0.091	<0.95	0.059	0.7-0.9
BARI-6 x PI-633165	68	46	16	6	2.041	0.3-0.5	0.769	0.3-0.5
Total	140	99	30	11	1.457	0.3-0.5	0.617	0.3-0.5
BC_1 population					2 : 1 : 1		3 : 1	
					χ^2	P	χ^2	P
(PI-633165 x BARI-6) x BARI-6	70	32	17	21	0.961	0.5-0.7	0.933	0.3-0.5

Fig 2: Seed color segregation in F_2 progenies



RESULTS AND DISCUSSIONS (CONTD.)

Inheritance of leaf hairiness in *B. rapa*

- The F_1 plants of the cross and reciprocal cross between a hairiness parent and non- hairiness parent had hairiness, indicating that hairiness was dominant over non- hairiness.
- The F_2 plants segregated with 3:1 ratio, and the backcross plants were segregated with 1:1 ratio for hairiness and non- hairiness confirming monogenic inheritance of the trait (Fig. 3, Table 2).

Table 2: Segregation of leaf hairiness in the F_2 and BC_1 of *B. rapa* crosses

Populations	Total plants	Pubescent	Non-pubescent	Segregation ratio	χ^2	P
F_2 populations						
PI-633165 x BARI-6	87	61	26	3 : 1	1.107	0.2-0.3
BARI-6 x PI-633165	76	53	23	3 : 1	1.123	0.2-0.3
Total	163	114	49	3 : 1	2.227	0.1-0.2
BC_1 populations						
(PI-633165 x BARI-6) x BARI-6	74	33	41	1 : 1	0.865	0.3-0.5

Fig 3: Morphology of leaf hairiness (left) and non- hairiness (right).

Joint segregation of seed color and leaf hairiness

The distribution of the plants for leaf pubescence and seed color was consistent with the phenotypic segregation ratio of 36:9:3:12:3:1 in the F_2, and 2:1:1:2:1:1 in the BC1 for these two independent characters. After pooling the brown seeded and yellow-brown seeded plants into one group and yellow plants into another group, the observed segregation was consistence with Mendelian 45:3:15:1 ratio in the F_2, and 3:1:3:1 in the BC1, confirming the independent segregation of the traits.

Table 3: Joint segregation of leaf hairiness & seed color in F_2 and BC_1 populations of *B. rapa* crosses based on the assumption of their independent inheritance

Populations	Total plants	hairiness			Non-hairiness			Segregation ratio			
								36:9:3:12:3:1		45:3:15:1	
		Brown	Yellow-brown	Yellow	Brown	Yellow-brown	Yellow	χ^2	P	χ^2	P
F_2 populations											
PI-633165 x BARI-6	72	36	9	4	17	5	1	2.444	0.7-0.9	2.311	0.5-0.7
BARI-6 x PI-633165	68	31	11	4	15	5	2	4.052	0.5-0.7	2.775	0.3-0.5
Total	140	67	20	8	32	10	3	5.435	0.3-0.5	4.518	0.2-0.3
BC_1 population								2:1:1:2:1:1		3:1:3:1	
								χ^2	P	χ^2	P
(PI-633165 x BARI-6) x BARI-6	70	18	7	8	14	10	13	3.372	0.5-0.7	2.381	0.3-0.5

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FUNDING

- NDSU-Center of Excellence for Agbiotechnology
- National Institute of Food and Agriculture (NIFA)
- State Board of Agricultural Research and Education's
- Northern Canola Growers' Association