

Inheritance of nodal pigmentation in Indian mustard (*Brassica juncea* L. Czern & Coss)

K. H. Singh*, R. K. Mahawar, Ritu Shakya and J. S. Chauhan

Directorate of Rapeseed Mustard Research, Sewar, Bharatpur 321 303

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Indian mustard (*Brassica juncea* L. Czern & Coss) is the predominant oilseed crop in India. In present scenario of safeguarding intellectual property rights, it is essential to establish distinctness among varieties for their easy identification. Morphological markers are very scanty in Indian mustard. Descriptors of rapeseed mustard varieties [1] suggests the need of additional characteristics to establish distinctness among varieties. Purple pigmentation at nodal regions has been reported in crops like rice [2] and cowpea [3]. Considering the importance of distinct morphological markers in identification of varieties, an experiment was conducted to study the genetics of purple nodal pigmentation. Four crosses were attempted during 2006-07 by crossing varieties devoid of pigmentation (NRCHB 101 and Rohini) with varieties having purple nodal pigmentation (PBR 97 and Jagannath). F₁ generation was raised during 2007-08 and F₂, BC₁ and BC₂ crosses were attempted. F₂ seeds were produced by selfing the F₁ plants to avoid any outcrossing. The F₂, BC₁ and BC₂ generations of all four crosses alongwith four parents were grown during winter of 2008-09 at Directorate of Rapeseed Mustard Research, Bharatpur. Observations on presence/absence of nodal pigmentation, days to appearance and disappearance of pigmentation, flower initiation and flower senescence were recorded. Presence/absence was recorded on single plant basis while days to appearance, disappearance, flower initiation and flower senescence were recorded on group of plants. On the basis of purple pigmentation, plants were grouped in to three distinct classes viz., pigmented,

intermediate and absent. Chi-square test was applied to test the goodness of fit for the segregation ratio. Observations on presence/absence of pigmentation were recorded on single plant basis at the time of flowering.

Total number of plants observed and segregation pattern for nodal pigmentation in populations derived from four crosses of Indian mustard is presented in Table 1. All plants in F₁ generation of all four crosses showed intermediate purple pigmentation at nodes indicating the incomplete dominance of the purple pigmentation. Segregation for presence, absence and intermediate nodal pigmentation was observed in F₂ generation. In all four crosses segregation fitted to an expected ratio of 1:2:1, suggesting monogenic inheritance with incomplete dominance of purple pigmentation (Table 1). In BC₁ (F₁ x Absent pigmentation), segregation to absent and intermediate type was observed which fitted to an expected ratio of 1 (absent): 1(intermediate) in all four crosses. In BC₂ (F₁ x Present pigmentation), segregation to present and intermediate type was observed that too fitted to expected ration of 1(present): 1 (intermediate) in all four crosses. These segregation ratios confirm the monogenic inheritance of purple nodal pigmentation with incomplete dominance. A comprehensive review on trait genetics in crucifers has been published [4]. We do not find any previous report on inheritance of nodal pigmentation in Indian mustard. Observations recorded on days to flower initiation, days to flower senescence, days to appearance of

*Corresponding author's e-mail: kharendrasingh@gmail.com

Table 1. Segregation of purple nodal pigmentation in populations derived from four crosses involving pigmented and nonpigmented varieties of Indian mustard

Generation	Pigmented	Non pigmented	Intermediate	Expected ratio	χ^2	P Value
Cross 1 (NRCHB 101 x PBR 97)						
BC ₁	0	28	25	01:01	0.17	0.92
BC ₂	27	35	0	01:01	1.03	0.60
F ₂	48	42	102	01:02:01	1.13	0.57
Cross 2 (NRCHB 101 x Jagannath)						
BC ₁	0	26	34	01:01	1.07	0.59
BC ₂	25	0	38	01:01	2.68	0.26
F ₂	34	48	78	01:02:01	2.55	0.28
Cross 3 (Rohini x PBR 97)						
BC ₁	0	21	17	01:01	2.42	0.30
BC ₂	35	0	33	01:01	0.06	0.97
F ₂	48	40	80	01:02:01	1.14	0.56
Cross 4 (Rohini x Jagannath)						
BC ₁	0	27	23	01:01	0.32	0.85
BC ₂	30	0	24	01:01	0.67	0.72
F ₂	34	38	78	01:02:01	0.45	0.80

**Fig. 1.** Phenotypes for purple nodal pigmentation in P₁ (Non pigmented), P₂ (Pigmented) and F₁ (Intermediate)

pigmentation and days to disappearance of pigmentation suggested close relationship ($r = 0.95$) between days to appearance of pigmentation and days to flower initiation. In general pigmentation appeared earlier (0-5 days) than the flower initiation. Similarly, close relationship ($r = 0.66$) was observed between days to flower disappearance of pigmentation and days to flower senescence. Disappearance of pigmentation occurred earlier (0-5 days) than the flower senescence, suggesting the synthesis of pigment during flowering phase only. The purple nodal pigmentation gives distinct phenotypes and may be used for identification of varieties or ascertaining the identity of hybrids. The purple nodal pigmentation was found absent in all

varieties of rapeseed group including *Brassica rapa* var toria, *B. rapa* var brown sarson, *B. rapa* var yellow sarson, *B. napus* and *Eruca sativa*. Pigmentation was present in all four varieties of karan rai (*B. carinata*) viz., JTC1, PC 5, Pusa Swarnim and Pusa Aditya. Variability for presence/absence of this marker was observed in varieties of Indian mustard (*B. juncea*). Out of 54 varieties studied in this experiment, nodal pigmentation was absent in eight varieties namely, Rohini, Navgold, NDRE 4, NDYR 8, NRCDR 2, NRCHB 101, RH 781 and Basanti.

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