NUCLEO-CYTOPLASMIC INTERACTIONS IN BRASSICA.

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Interspecific nuclear substitution and its manifestation in the altered phenotypic expression is of immense genetic significance. Cytoplasmic variability has been best documented in *Triticum* by the nuclear substitution technique (Kihara, 1951 ; Fukasawa, 1953 ; Mann, 1977). The phenotypic differences among the resultant alloplasmic lines have been linked to cytoplasmic differences among the cytoplasm donating species. Relatively little is published regarding the cytoplasmic variability, and cytoplasm differentiating nuclear genes in *Brassica*. This paper describes the agronomic performance of *Brassica juncea* cultivar RLM 198 and its various alloplasmic lines in seventh backcross generation.

MATERIAL AND METHODS

B. juncea C.V. RLM 198 genome (AABB) was transferred into the cytoplasm of six *Brassica* species viz. *B. japonica* (AA), *B. chinensis* (AA), *B. campestris* (AA), *B. nigra* (BB), *B. napus* (AACC) and *B. carinata* (BBCC) by backcross substitution method. Five rows each of the six resultant alloplasmic lines alongwith euplasmic parent were grown during winter, 1981 in a randomised complete block design with two replications. Twelve pre- and post harvest characters were studied. The foliage disease intensity to *Alternaria* blight was calculated by the technique as given by Gemawat and Prasad (1969).

RESULTS AND DISCUSSION

The influence of alien cytoplasms on various morphological and physiological attributes of *B. juncea* is presented in table 1. In general, adverse effect on plant vigour was manifest in all the alloplasmic lines. The cytoplasms of two 'A' genome species (*B. japonica* and *B. chinensis*) had minimum detrimental effect on any of the vegetative or reproductive attributes. *B. campestris* (AA) cytoplasm, on the other hand, influenced almost all vegetative traits rather severely, with some effect on male or female gametophyte. In addition, it led to raceme modification whereby the flowers were arranged in close spirals resulting in completely appressed and twisted pods without any false septum. Alloplasmic line with *B. nigra* cytoplasm had a high incidence of anther malformation (48.6%) with some reduction in pollen fertility. Some completely male sterile plants were also recovered in BC5 but the male sterility expression was unstable at higher temperatures.

Substitutions with *carinata* and *napus* cytoplasms resulted in complete male sterility. Anthers were reduced and indehiscent (Fig. 1) with little or no fertile pollen. In addition, these alloplasmic lines had increased number of primary and secondary branches with lower incidence of *Alternaria* blight.

Different nucleo-cytoplasmic combinations resulted in altered expression of various leaf pigments. The alloplasmic lines with *campestris, chinensis* and *carinata* had reduced chl-a and chl-b but total carotenoids were increased. Reverse trend was observed for *B. japonica* and *B. napus* cytoplasms. *B. nigra* cytoplasm was associated with greater level of chl-b. Such chlorophyll abnormalities have usually been encountered in a large number of nucleo-cytoplasmic combinations (Kato and Tokumasu, 1980). The physiological and morphological aberrations in various NC combinations can be attributed to cytoplasmic differences or to the lack of complementation between the nuclear and cytoplasmic genes. The cytoplasmic donor species are also the source of such complementary, correcting nuclear genes.

The alloplasmic *B. juncea* with cytoplasms of 'A' genome species had normal fertility and plant vigour. This shows that *B. juncea* has cytoplasmic homology with its diploid progenitor belonging to 'A' genome species. Alloplasmic *B. juncea* with cytoplasms of *napus* and *carinata* were completely male sterile. Apparently neither of them could have cytoplasmic affinity with *B. juncea* as well as with 'A' genome species. Therefore *B. oleracea* (CC) is the likely cytoplasmic donor to *B. napus* and any one of *B. oleracea* and *B. nigra* could have contributed its cytoplasm to *B. carinata*. Shiga (1979) showed that *B. carinata* cytoplasm is different from *B. napus* cytoplasm. Thus *B. nigra* has greater chances of sharing cytoplasmic affinity with *B. carinata*. This gets support from the electrofocusing analysis of fraction 1 protein where *B. carinata* and *B. nigra* have been grouped together (Uchiyama and Wildman, 1978). This must, however, be realised that genetic relatedness of different cytoplasms does not necessarily mean their phylogenetic relationship.

The cytoplasmic substitution lines produced during these studies are important because of their potential use in furnishing male sterile lines, adopting new cultural practices, creating morphological and biochemical variation in addition to introducing cytoplasmic variability in mustard improvement programmes.

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Table 1 : Effect of alien cytoplasm on some characters of Brassica juncea (L.) Coss.

Character	Alien cytoplasm						Original juncea CV RLM 198
	japonica	chinensis	campestris	nigra	napus	carinata	
Pollen fertility (%)	84.15a	89.10a	78.77a	64.85a	0.54b	1.83b	92.30a
Anther malformation (%)	3.68a	1.91a	21.22a	48.60ab	98.00b	97.85b	61.20a
Open pollinated fertility (%)	84.33a	79.85a	65.83a	46.68ab	9.65b	10.85b	92.70a
Seed setting (%)	69.12a	72.08a	65.68a	49.06a	0.12b	0.19b	82.68a
Plant height (cm)	132.02a	151.03a	79.26b	142.06a	156.50a	89.20b	143.37a
Primary branches	3.98a	6.66a	3.67a	5.16a	19.05b	14.68b	5.00a
Secondary branches	11.82acd	6.84cd	4.83d	6.17cd	31.15b	22.61ab	16.33a
Yield (g)	6.84a	4.58a	2.95b	1.82b	0.35b	0.88b	6.55a
Alternaria intensity (%)	51.89b	63.42b	69.94b	45.89a	28.13a	31.82ac	47.52a
+ Chlorophyll-a (mg/g)	9.91	3.01	4.05	3.11	4.66	3.15	3.70
+ Chlorophyll-b (mg/g)	2.94	2.02	1.74	3.64	3.01	1.74	2.59
+ Carotenoid (mg/g)	0.12	0.20	0.17	0.04	0.20	0.19	0.12

+ Unreplicated.

a-d Means with in row followed by same letter do not differ significantly according to Duncan's multiple range test (P = 0.05).

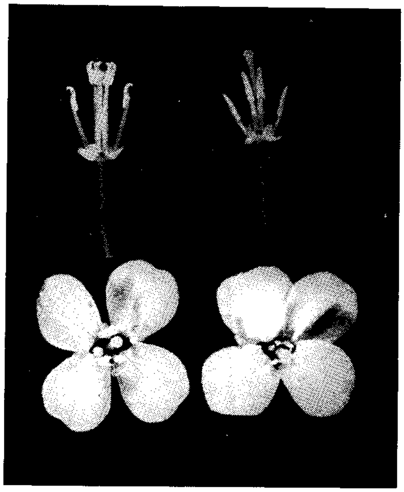

FIG.1: Floral morphology of Euplasmic and Alloplasmic (*napus*) *B. juncea*.