GENETICS OF SOME QUALITY CHARACTERS IN YELLOW SEEDED INDIAN MUSTARD (BRASSICA JUNCEA (L.) CZERN & COSS.)

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Mustard is an important oilseed crop of Northern India. Indian mustard is brown to black seeded, however, some strains having yellow seed coat colour have been developed. Yellow seeded types producing pale yellow coloured oil and light coloured protein products have consumers preference. Reports on the nature of gene action governing the quality traits in yellow seeded types especially on husk content, refractive index, iodine number, protein content, sum of oil and protein content are scanty. The present study was undertaken to evaluate the newly developed strains and decipher nature of gene action for formulating suitable breeding methodology for improvement of different quality traits in Indian mustard.

MATERIALS AND METHODS

Eight strains and their 28 F_3 populations of yellow seeded Indian mustard were sown on November 8, 1978 in a randomized block design with two replications. Each plot consisted of 2 rows 3 m long and 50 cm spaced apart. The distance of 15 cm between the plants was maintained by thinning. Twenty randomly selected plants from each plot in each replication were harvested and threshed. Observations were recorded on 1000 seed weight (g), husk content (%), refractive index, iodine number, protein content (%) and sum of oil and protein content (%). Thousand seeds were randomly sampled from each of the population and weighed on electrical balance in grams. For husk content pre-weighed seeds were soaked in water for about 30 hours and the husk was removed. The dehusked seeds were dried and weighed. The difference was recorded as husk content. The oil residue from soxhlet extraction was filtered and refractive index was measured by Abbe-Refractometer. A correction factor of 0.00037 for each degree centigrade room temperature was applied and the values were expressed at 25°C. Readings were measured in day light. The iodine number of oil was determined by Hanus method (Jamieson, 1943), the protein content of the cake left after oil extraction was estimated by using

Kjeldahl method (A.O.A.C., 1941). The factor was used for conversion of nitrogen values to their corresponding protein values.

Combining ability analysis was carried according to Griffing (1956), method 2 and model 1.

RESULTS AND DISCUSSION

Analysis of variance showed significant differences among genotypes for all the characters under study. Parents and crosses also differed among themselves. Variances due to parents vs. crosses were significant for all the characters except iodine number (Table-1).

Variances due to general and specific combining ability for 1000-seed weight, husk content, refractive index, iodine number, protein content, sum of oil and protein content were highly significant. This indicated the importance of both additive and non-additive genetic components in the present material. The estimates of components of variance revealed that O^2 g was higher than O^2s for refractive index and protein content suggesting the predominant role of additive gene action in the inheritance of these characters. Average degree of dominance also showed partial dominance. Grami and Stefansson (1977) and Stefansson (1978) have also reported the importance of additive gene action for protein content.

The estimates of O^2g were lower than O^2s for 1000-seed weight, husk content, iodine number, sum of oil and protein content. Average degree of dominance also showed over dominance. These findings are in agreement with that of Chauhan and Singh (1981) for 1,000 seed weight and Masood et al. (1979) for refractive index and iodine number.

Heritability estimates in narrow sense were high for iodine number and protein content, medium for husk content, sum of oil and protein content and low for 1000 seed weight and refractive index. Grami et al. (1977) have also reported moderate heritability for sum of oil and protein content in summer rapeseed.

Genetic advance in per cent of mean was also low for refractive index, medium for 1000-seed weight, husk content, iodine number, sum of oil and protein content and high for protein content.

Combining ability effects :

Estimates of gca effects (Table-2) revealed that the parents K_3, K_7, K_1 for 1000 seed weight, K_1 , K_7 , K_2 for low husk content, K_5 for refractive index, K_4 for low iodine number, K_3 , K_4 , K_5 for protein content and K_6 , K_2 , K_8 for sum of oil and protein content were good general combiners. Parents K_5 , K_3 , K_4 and K_2 may be utilized in multiple crossing programme.

Estimates of specific combining ability effects showed that $K_5 \times K_6$, $K_2 \times K_4$ for higher seed weight, $K_1 \times K_2$, $K_6 \times K_8$, $K_5 \times K_7$ for low husk content, $K_3 \times K_6$, $K_4 \times K_8$, $K_1 \times K_6$ for low refractive index, $K_2 \times K_6$, $K_3 \times K_6$, $K_2 \times K_7$ for low iodine number $K_3 \times K_8$, $K_4 \times K_5$, $K_1 \times K_5$ for high protein content and $K_4 \times K_6$, $K_6 \times K_8$, $K_2 \times K_7$ for high sum of oil and protein content were desirable.

$K_3 \times K_5$ involved high x high general combiners for protein content, which may give rise to transgressive segregants in the future generations.

Character Associations :

At phenotypic level, 1000 seed weight showed positive association with refractive index, iodine number, protein content and sum of oil and protein content and negative association with husk content. Husk content was positively correlated with refractive index and iodine number and negatively correlated with protein and sum of oil and protein content. The associations of refractive index and iodine value with all other characters were positive. Protein content showed positive correlation with sum of oil and protein content.

Genotypic correlation showed positive association of 1000 seed weight with husk content, protein content, iodine number, sum of oil and protein content. This suggested that improvement in protein content and sum of oil and protein content may be done by increasing seed size. Bengtsson et al. (1974) reported positive association between 1000 seed weight and protein content. Husk content was found to be positively associated with protein content but negatively correlated with sum of oil and protein content. Refractive index showed negative association with 1000 seed weight, protein content and sum of oil and protein content and positive association with husk content and iodine number. Pathak et al. (1973) have also found significant positive correlation between refractive index and iodine value. The association between protein content and sum of oil and protein content was positive. Iodine number was found to be positively associated with all the characters. Downey et al (1975) observed that despite the negative correlation between per cent protein and percent oil, positive advance for both traits could be made simultaneously in the same programme. Moreover, yellow seed coat associated with lower fibre content will further decrease the residual fraction and increase both protein and oil content considerably.

Proposed breeding Methodology :

In the light of findings of the present investigation, it is proposed to suggest a suitable breeding methodology for improvement of quality traits. For refractive index and protein content additive gene action was predominant and average degree of dominance showed partial dominance. Heritability and expected genetic advance were also high for protein content. These characters may be improved through biparental mating design

III of Comstock and Robinson (1952).

Husk content, 1000 seed weight, iodine number and sum of oil and protein content have shown predominance of non-additive gene action and over dominance. They have also exhibited considerable amount of additive gene action. Thus, improvement of these characters should be based on the simultaneous exploitation of both additive and non-additive components of genetic variability. Thus, mass selection with concurrent random mating as suggested by Redden and Jensen (1974) would be most appropriate breeding procedure. Diwakar (1979) has also suggested similar breeding methodology for improvement of yield and oil characters in the present material.

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Table 1 : Analysis of variance for combining ability for quality characters in Indian mustard.

Source of variation	D.F.	Mean squares					
		1000-seed weight	Husk content	Refractive index	Iodine number	Protein content	Sum of oil and protein content
Replication	1	0.009	1.1909	0.5×10^{-4}	8.37	2.57	5.7687
Genotype	35	0.2523**	2.0683**	0.18×10^{-4} **	40.3965**	11.40**	18.461**
Parent	7	0.2757**	2.4963**	0.20×10^{-4} **	41.5068**	11.50**	24.93**
Cross	27	0.25**	1.9091**	0.18×10^{-4} **	40.2273**	11.10**	16.57**
Pvs C	1	0.15**	4.5616**	0.6×10^{-4} **	23.69	18.83**	24.14**
G.C.a.	7	0.0631**	1.672**	0.43×10^{-4} **	16.36*	57.78**	23.67**
S.C.a.	28	0.1415**	0.872**	0.11×10^{-4} **	21.17**	5.71**	9.19**
Error	35	0.0104	0.377	0.11×10^{-5}	5.74	0.762	1.73
Estimates of genetic components							
0^2g		0.0078	0.212	0.32×10^{-4}	4.81	5.21	1.448
0^2s		0.1311	1.936	0.96×10^{-5}	15.43	4.95	7.449
(0^2s/2 0^2g) 1/2		2.90	2.16	0.38	5.01	0.68	1.60
Heritability (%)		9.31	15.18	8.572	31.24	64.60	23.95
Genetic advance in percent of mean		2.57	5.29	0.1043	3.57	14.52	2.27

* *Significant at 5% level*

** *Significant at 1 % level*

Table-2 : Estimates of general combining ability effects for some characters in 8 x 8 diallel cross of Indian mustard

Parents	1000 seed weight	Mean	Husk content	Mean	Refactive index	Mean	Iodine number	Mean	Protein content	Mean	Sum of oil & protein content	Mean
K_1	0.091**	3.288	−5.085**	8.29	0.0004	1.468	1.174	97.24	− 1.72**	37.65	−1.052**	74.95
K_2	−0.113**	2.983	−2.385**	8.91	−0.0006	1.465	0.492	105.44	−13.45**	35.84	0.944**	76.32
K_3	0.111**	3.548	5.865**	10.64	0.0007*	1.471	1.512	103.16	13.74**	41.15	0.176	74.79
K_4	−0.014	2.722	1.655**	10.96	0.0008*	1.473	−2.335**	93.46	2.51**	36.17	−1.259**	67.50
K_5	−0.009	3.229	0.945**	7.95	−0.0009*	1.464	−0.278	97.15	2.05**	38.93	−0.683	78.22
K_6	−0.023	2.491	−1.115**	8.56	0.0000	1.465	0.605	103.71	− 1.99**	33.68	1.351**	74.90
K_7	0.100**	3.356	−3.695**	9.40	−0.0001	1.466	0.111	94.78	0.77*	37.58	−0.250	71.85
K_8	0.001	3.460	5.705**	10.09	−0.0005	1.466	−1.279	95.92	− 1.87**	40.41	0.775	78.20
S.E. (ĝi)	0.030		0.181		0.00031		0.7087		0.2582		0.3891	
S.E. (ĝi-ĝj)	0.045		0.274		0.00047		1.0714		0.3904		0.5882	

* *Significant at 5 %level*

** *Significant at 1 % level*