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Genetic Variability and Character Association in Rapeseed (*Brassica rapa* L.) under Organic Cultivation

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A B S T R A C T

A set of 15 rapeseed genotypes including five yellow sarson and ten toria genotypes, was evaluated following organic cultural practices during *Rabi* 2017-18 and *Rabi* 2018-19 to assess genotypic performance, genetic variability and character interrelationship. The pooled analysis of variance revealed significant variation due to genotypes, environments and genotype-environment. JYS14-2, PYS2012-1, JT13-1 and JT13-5 were found as promising genotypes. Analysis of genetic parameters revealed high heritability and genetic advance for days to 50% flowering, leaf size and main shoot length indicating that these three characters were under the influence of additive gene action. For these characters significant genotypic variation was observed. Correlation and path analysis exhibited that main shoot length and leaf size were the most important yield attributes for organic rapeseed breeding.

Introduction

The family *Brassicacae*, containing about 350 genera and 3500 species, is one of the ten most economically important plant families with a wide range of agronomic traits (Rich, 1991; Christopher *et al.,* 2005). Indian rapeseed (*Brassica rapa* L.) is a polymorphic oleiferous Brassica species. There are three agro-morphologically distinct ecotypes of Indian rapeseed, namely brown sarson, yellow sarson and toria (Singh, 1958; Prakash and Hinata, 1980). Yellow sarson and tora type of brown sarson are self compatible and largely self pollinated whereas toria and lotni type of brown sarson are self incompatible and highly cross pollinated. According to the National Mission on Oilseeds and Oil Palm (NMOOP, 2016), the estimated area, production and yield of rapeseed-mustard in the world was 35.52 million hectares, 71.45 million tonnes and 2010 kg/ha, respectively. Oilseed rape (*B. napus* L.) is the predominant species worldwide. In India oilseed brassicas are cultivated in 5.746 million hectares, producing 6.797 million tonnes with average yield of 1183 kg/ha as in 2015-16 (DOR, http://oilseeds.dac.gov.in/Introduction.aspx).
In India, *B. juncea* is the predominant Brassica species. However, in Assam toria is the major oilseed crop; yellow sarson is grown to lesser extent. In the recent time

attempts are also made to introduce short duration Indian mustard varieties.

In view of the adverse effects of chemicals (insecticides, pesticides, weedicides, chemical fertilizers) on human health, soil health and environment, organic cultivation is gaining increasing significance all over the world. Organic farming is a production system that avoids the use of synthetic chemical fertilizers, pesticides and growth regulators, and crops are raised in holistic manner with use of organic manure, crop rotation with legumes, green manures and biological pest control. Use of organic manure not only reduces the requirement of chemical fertilizers but also supplements of all essential nutrients to the plants besides improving the soil properties (Purakayastha *et al.*, 2008). Organic farming is gaining gradual momentum across the world. The current trend is to explore the possibility of supplementing chemical fertilizers with organic ones which are eco-friendly and cost effective (Datta *et al.*, 2009).

There is a need to breed varieties for organic farming situations. Such varieties are generally morpho-physiologically different from the varieties under conventional faming situation. Development of superior early maturing varieties having adaptability to organic farming condition is necessary. With this in view the present investigation was undertaken to evaluate performance of genotypes of Indian rapeseed and to assess genetic variability under organic farming situation.

Materials and Methods

The experiments were carried out in the organic block of the Instructional cum Research Farm, Assam Agricultural University, Jorhat (26°44′ N and 94°10′ E) at an elevation of 91 m above MSL (www.aau.ac.in) during *Rabi* season of 2017-18 and 2018-19. Fifteen genotypes comprising five yellow sarson (B9, PYS2012-1, BNYS-1, JYS13-2, JYS14-2) and ten toria genotypes (Jeuti, M27, TS36, TS38, TS46, TS67, JT13-1, JT13-1-1, JT13-2, JT13-5) were sown in randomized block design in three replications. Each plot contained 3 rows of 4 m long. Row to row spacing was 30 cm and plant to plant spacing within row was adjusted to about 10 cm by thinning at seedling stage. The field was prepared well to fine tilth and leveled before application of manures. Well decomposed cow dung and vermicompost were applied as basal application @ 2 t/ha. Crops were raised as rainfed with minimal life saving irrigation by sprinkling water manually at seedling emergence, active vegetative and flowering to pod filling stages. Random 10 plants per plot were sampled to record data for eleven quantitative characters. Days to 50% flowering (DF) and days to maturity (DM) were observed on plot basis. Number of leaves per plant (LN) and leaf size (LS) in square cm were recorded at 30 days after sowing. Number of primary branches per plant (PB), main shoot length (MSL) measured in cm and number of siliquae on main shoot (SMS) was recorded at pod maturing stage. Maximum root length in cm (MRL), thousand seed weight measured in gram (TSW) and seed yield per plant in gram (SYP) were recorded after harvest. Pooled analysis of variance for each character was done on the basis of plot mean values by standard statistical procedure (Gomez and Gomez, 1984). Genotypic variances (σ^2_g), phenotypic variance (σ^2_p) and environmental variance (σ^2_e) were computed by following standard procedure as given in Singh and Chaudhary (1979). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated from these variances following Burton and Devane (1953). Heritability (h^2) in broad sense and the expected genetic advance was calculated by using the formula suggested by Johnson, Robinson and Comstock (1955). Genetic advance was expressed as percentage of the grand mean. Simple linear correlation coefficients were computed by standard formula (Gomez and Gomez, 1984) on mean values of two years. Path coefficient analysis was carried out on the basis of simple linear correlation coefficients to study the direct and indirect effects of the yield components on seed yield per plant following the method given by Dewey and Lu (1959).

Results and Discussion

Significant variation was observed among the genotypes for all the eleven characters (Table 1). Environmental effects of the two years were significant for days to flowering, plant height, main shoot length, thousand seed weight and seed yield per plant. Genotype-environment interactions were highly significant for all the characters. This indicated that performances of the genotypes were not consistent over the two years. From the mean performance over the two years (Table 2) it was observed that Jeuti, JT13-1, JT13-1-1 and TS67 were early flowering genotypes. JT13-1-1, Jeuti and TS38 were early in maturity. BNYS-1, JT13-2, B9, JT13-1 and JT13-1-1 produced significantly larger number of leaves than the other genotypes at vegetative phase; whereas PYS2012-1 and TS 36 produced larger leaves than the others. JT13-1, TS38 and TS67 also produced larger leaves. It is assumed that more and larger leaves would give advantage at early crop growth under organic farming situations to compete with weeds. For plant height PYS2012-1 was the tallest genotype growing to a height of 70.82 cm. JYS14-2, JT13-5, BNYS-1, TS38, JT13-1 and JT13-1-1 were other tall growing genotypes. PYS2012-1, JYS14-2, JT13-5 and JT13-2 produced more primary branches per plant. PYS2012-1 produced the longest main shoots (56.08 cm). JYS14-2, JT13-5 and BNYS-1 also produced comparatively longer main shoots. For siliquae on main shoot B9 (28 siliquae on MS), JYS14-2, TS36, JYS13-2 and JT13-1 were the genotypes bearing significantly more number of siliquae on main shoot. Thousand seed weight was significantly higher in the genotypes PYS2012-1 (3.369 g/1000), B9, JYS14-2 and TS46 (3.135 g/1000). On the other hand maximum root length was high for the genotypes TS38 (23.81 cm), TS67, JYS14-2, and TS36 (22.98 cm). Longer roots have advantage in rainfed farming. JYS14-2 produced the highest seed yield per plant (5.35 g/plant) over the two years.

The genotypes JT13-1, PYS2012-1, JT13-5 and TS38 were at par and consistently superior to others for seed yield per plant under organic culture. However, the other genotypes also showed good performance for certain yield attributes. Thus it was revealed that JYS14-2, PYS2012-1, JT13-1 and JT13-5 were promising genotypes. Except PYS2012-1 the other entries were newly developed genotypes. Mahanta and Barua (2019) also evaluated some newly developed rapeseed populations under conventional farming and observed variation and identified promising genotypes.

From the genetic variability parameters estimated from the pooled analysis (Table 3 and Figure 1) medium genotypic variation was observed for days to 50% flowering (15.42%), main shoot length 13.55%), leaf size (13.31%), seed yield per plant (10.84%) and plant height (10.52%). High broad-sense heritability was observed for days to maturity (96.21%), days to 50% flowering (96.12%), leaf size (86.65%), maximum root length (84.83%) and main shoot length (82.58%). On the other hand high estimate of genetic advance was observed for only days to flowering (31.14%).

Table.1 Pooled ANOVA for different characters in rapeseed under organic culture during *Rabi* 2017-18 and 2018-19

Source	df	DF	DM	LN	LS	PH	PB	MSL	SMS	MRL	TSW	SYP
Environments (E)	1	8.71**	0.04	0.39	0.23	839.67**	0.44	4231.93 **	0.2	1.51	0.20*	1.89**
Replications/E	4	0.36	0.64	0.55	0.02	83.27**	0.59**	102.98**	65.72**	0.51	0.09	0.78**
Genotypes (G)	14	80.61**	27.68**	1.34**	3.86**	138.44**	0.58**	125.66**	22.07**	7.21**	0.19**	0.95**
G x E	14	14507.35**	104714.52**	421.49**	896.60**	47154.98**	128.99**	27666.53**	8020.25**	6245.13**	117.42**	282.98**
Pooled error	56	1.07	0.36	0.42	0.19	17.41	0.15	8.26	8.08	0.41	0.05	0.18
CV (%)		3.1	0.66	11.31	5.22	6.91	12.1	6.23	11.41	2.89	7.18	9.18

DF= Days to 50% flowering, DM=Days to maturity, LN= Leaf number, LS= Leaf size, PH= Plant height, PB= Primary branches/plant, MSL= Main shoot length, SMS= Siliqua on main shoot, MRL= Maximum root length, TSW= Thousand seed weight, SYP= Seed yield per plant

Table.2 Mean values for different characters in rapeseed under organic culture during *Rabi* 2017-18 and 2018-19

Genotype	DF	DM	LN	LS	PH	PB	MSL	SMS	MRL	TSW	SYP
B9	32.80	90.70	6.24	7.25	60.15	3.17	46.52	28.00	20.62	3.265	4.285
PYS2012-1	31.85	88.65	5.69	9.56	70.82	3.85	56.08	24.75	21.12	3.369	5.070
BNYS-1	39.00	90.50	6.53	7.16	64.27	2.74	49.02	21.79	20.90	3.033	3.985
JYS13-2	34.80	92.35	5.62	8.00	60.27	3.42	45.90	25.35	20.47	2.979	4.670
JYS14-2	36.80	88.65	5.55	7.97	65.52	3.55	51.70	27.35	23.18	3.217	5.350
Jeuti	26.50	86.85	5.38	7.34	57.27	2.99	43.42	25.19	22.02	2.781	4.520
M27	32.85	90.85	5.50	8.01	58.49	3.29	44.30	25.05	22.50	3.073	4.460
TS36	33.65	90.15	5.08	9.87	56.44	2.85	42.32	26.02	22.98	3.097	4.840
TS38	32.50	87.85	5.04	8.88	61.37	2.82	46.68	23.10	23.81	2.876	4.955
TS46	34.15	89.80	5.45	8.02	50.67	3.05	38.48	22.05	22.31	3.135	4.565
TS67	31.00	90.30	5.37	8.66	55.39	3.14	39.35	24.24	23.55	2.872	4.045
JT13-1	30.65	90.50	6.18	9.16	61.04	2.82	47.50	25.19	22.45	2.887	5.155
JT13-1-1	30.00	85.35	6.00	8.10	60.88	3.03	46.35	23.15	21.91	2.891	4.490
JT13-2	41.50	94.85	6.49	8.45	58.34	3.17	44.20	24.40	20.62	2.973	4.645
JT13-5	32.85	92.00	5.48	8.31	64.69	3.43	50.47	27.97	21.79	2.787	5.045
Mean	33.40	90.20	5.71	8.31	60.37	3.15	46.15	24.91	22.01	3.015	4.675
SE (mean)	0.42	0.24	0.26	0.18	1.70	0.16	1.17	1.16	0.26	0.091	0.173
CD5%	1.19	0.69	0.75	0.50	4.82	0.45	3.32	3.28	0.74	0.258	0.490

DF= Days to 50% flowering, DM=Days to maturity, LN= Leaf number/plant, LS= Leaf size (cm^2), PH= Plant height (cm), PB= Primary branch number/plant, MSL= Main shoot length (cm), SMS= No. of siliquae on main shoot, MRL= Maximum root length (cm), TSW= Thousand seed weight (g), SYP= Seed yield per plant (g).

Table.3 Estimates of genetic parameters estimated from pooled analysis in rapeseed under organic culture

Character	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability in broad sense (%)	Genetic advance as % of mean
Days to 50% flowering	15.42	15.72	96.12	31.14
Days to maturity	3.35	3.41	96.21	6.76
Leaf number	9.73	14.92	42.54	13.08
Leaf size (cm^2)	13.31	14.30	86.65	25.52
Plant height (cm)	10.52	12.59	69.85	18.11
Primary branches/Plant (No.)	5.60	7.67	53.32	11.53
Main shoot length (cm)	13.55	14.92	82.58	25.37
Siliquae on main shoot (No.)	8.67	14.33	36.61	10.81
Maximum root length (cm)	6.84	7.43	84.83	12.98
1000 seed weight (g)	7.15	10.13	49.82	10.40
Seed yield per plant (g)	10.84	14.21	58.23	17.04

Table.4 Simple linear correlation coefficients between different characters in rapeseed based on pooled means from two years

	DM	LN	LS	PH	PB	MSL	SMS	MRL	TSW	SYP
DF	0.459	0.463	-0.102	0.104	0.054	0.107	-0.114	-0.344	0.307	-0.032
DM		0.268	-0.126	-0.204	0.067	-0.198	0.264	-0.450	-0.131	-0.119
LN			-0.384	0.231	-0.103	0.240	-0.115	0.696**	0.133	-0.293
LS				0.118	0.100	0.100	0.030	0.387	0.093	0.526*
PH					0.515*	0.985**	0.274	-0.252	0.289	0.433
PB						0.536*	0.460	-0.258	0.477	0.383
MSL							0.314	-0.282	0.345	0.520*
SMS								-0.076	0.145	0.417
MRL									-0.243	0.245
TSW										0.123

* Significant at 5% probability level; ** Significant at 1% probability level DF= Days to 50% flowering, DM=Days to maturity, LN= Leaf number, LS= Leaf size, PH= Plant height, PB= Primary branches/plant, MSL= Main shoot length, SMS= Siliqua on main shoot, MRL= Maximum root length, TSW= Thousand seed weight, SYP= Seed yield per plant

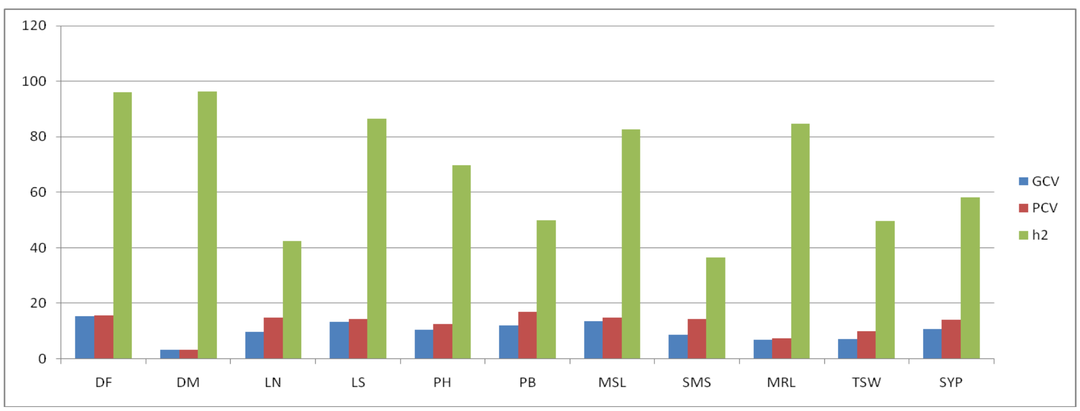
Table.5 Direct (diagonal) and indirect effects of different characters on seed yield per plant in rapeseed under organic culture

	DF	DM	LN	LS	PH	PB	MSL	SMS	MRL	TSW	r with SYP
DF	**0.235**	-0.023	-0.044	-0.044	-0.367	0.010	0.430	-0.015	-0.095	-0.118	-0.032
DM	0.108	**-0.051**	-0.026	-0.054	0.721	0.012	-0.793	0.035	-0.123	0.051	-0.119
LN	0.109	-0.014	**-0.095**	-0.165	-0.815	-0.019	0.964	-0.015	-0.191	-0.052	-0.293
LS	-0.024	0.006	0.037	**0.429**	-0.415	0.018	0.400	0.004	0.106	-0.036	0.526*
PH	0.024	0.010	-0.022	0.050	**-3.528**	0.094	3.948	0.037	-0.069	-0.111	0.433
PB	0.013	-0.003	0.010	0.043	-1.819	**0.183**	2.150	-0.035	-0.071	-0.184	0.383
MSL	0.025	0.010	-0.023	0.043	-3.474	0.098	**4.009**	0.042	-0.077	-0.133	0.520*
SMS	-0.027	-0.013	0.011	0.013	-0.966	0.084	1.258	**0.134**	-0.021	-0.056	0.417
MRL	-0.081	0.023	0.066	0.166	0.890	-0.047	-1.131	-0.010	**0.275**	0.094	0.245
TSW	0.072	0.007	-0.013	0.040	-1.018	0.087	1.382	0.019	-0.067	**-0.386**	0.123

Residual = 0.210

* Significant at 5% probability level

Fig.1 Genetic parameters for seed yield/plant and component traits in rapeseed under organic culture



DF= Days to 50% flowering, DM=Days to maturity, LN= Leaf number, LS= Leaf size, PH= Plant height, PB= Primary branch number, MSL= Main shoot length, SMS= Siliqua on main shoot, MRL= Maximum root length, TSW= Thousand seed weight, SYP= Seed yield per plant.

Medium genetic advance was observed for leaf size (25.52%) and main shoot length (25.37%). High heritability and high genetic advance indicate predominance of additive gene action in the inheritance of the characters (Johnson *et al.*, 1955). In the present study three characters viz. days to 50% flowering, leaf size and main shoot length showed such an indication that these three characters were under the influence of additive gene action. For these characters significant genotypic variation was observed in the present study. Simple selection is likely to be effective for the characters. On the contrary, seed yield and its attributes like seed weight, plant height and silique on main shoot were probably more influenced by non-additive gene action. Gogoi and Barua (2018) also reported similar findings for days to flowering in rapeseed. For majority of the characters non-additive gene action was probably more important. Preponderance of non-additive gene action is integral part of genetic variation in rapeseed (Barua, 1992). Thus usable genetic variation in selection was observed in the present materials for certain yield attributes.

From the analysis of simple linear correlation coefficients based on mean values over two years (Table 4), it was observed that seed yield per plant was positively correlated with leaf size (r=0.526) and main shoot length (0.520). Main shoot length was positively correlated with plant height (0.985) and number of primary branches (0.536). Maximum root length was positively correlated with leaf number per plant (0.696). Positive correlation was also observed between number of primary branches and plant height (0.515). Similar correlations were reported by Mahla *et al.*, (2003), Kardam and Singh (2005), Singh *et al.*, (2013), Meena *et al.*, (2014) and Tiwari *et al.*, (2017) in Indian mustard.

Path analysis was carried out on the basis of linear correlation coefficients. It was observed (Table 5) that main shoot length exhibited the highest direct effect (4.009) on seed yield per plant. Leaf size with direct effect of 0.429 was another important yield attribute. These two characters were also positively correlated with seed yield per plant. Moreover it was noted earlier that genetic variation and heritability were also significant for these two characters. To lesser extent maximum root length, number of siliquae on main shoot, days to 50% flowering and primary branches per plant were other important yield attributes having positive direct effects but having non-significant correlation with seed yield.

In the present study, on the basis of performance evaluation over two years 2017-18 and 2018-19 in organic farming conditions JYS14-2, PYS2012-1, JT13-1 and JT13-5 were promising genotypes. On the other hand on the basis of correlation analysis, path analysis and genetic variability parameters it could be concluded that main shoot length and leaf size were important yield attributes for selection in organic plant breeding for improvement of seed yield in Indian rapeseed.

References

Altieri M, Nicholls FN. 2003. Tolerance and effect of leaf fertilization treatments on vegetables. Gartebauwissenscharft. 51: 58-62.

Barua, P. K. 1992. Genetic analysis of yield parameters in varietal hybrids of Indian rapeseed (*Brassica campestris* L.). Ph. D. Thesis, Assam Agricultural University, Jorhat.

Burton, G.W. and DeVane, E.H. 1953. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J.* 45: 478-481.

Datta JK Banerjee, Sikdar A, Saha M, Gupta S and Mondal NK. 2009. Impact of combined exposure of chemical, fertilizer, bio- fertilizer andcompost on growth, physiology and productivity of *Brassica campestris* in old alluvial soil. *J Environ Biol* 30: 797–800.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path analysis of components of crested wheat grass seed production. *Agron. J.* 51: 515-518.

DOR, http://oilseeds.dac.gov.in/Introduction.aspx

Gogoi, Smrita and Barua, Purna K. 2018. Evaluation of selected segregating populations of Indian rapeseed (*Brassica rapa* L.) for yield and yield related traits. *Int. J. Curr. Microbiol. App. Sci.* 7(9): 1470-1477.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedure for agricultural research. John Wiley and Sons, New York.

Johnsson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybeans. *Agron. J*. 47: 314-318.

Kardam, D.K. and Singh, V.V. 2005. Correlation and path analysis in Indian mustard *(Brassica juncea* L.) Czern and Coss) grown under rainfed condition. *J. Spices Aromatic Crops* 14(1): 56-60.

Mahanta, Mayurakshee and Barua, Purna Kanta (2019). Genetic Variability Studies for Agro-Morphological, Yield and Yield Attributing Traits in Rapeseed (*Brassica rapa* L.) Int. J. Curr. Microbiol. App. Sci 8(9): 927-935.

Mahla, H.R., Jambhulkar, S.J., Yadav, D.K. and Sharma, R. 2003. Genetic variability, correlation and path analysis in Indian mustard [*Brassica juncea* (L.) Czern and Coss]. *Indian J.Genet.* 63(2): 171-172.

Meena, H.S., Ram, B., Kumar, A., Singh, B.K., Meena, P.D., Singh, V.V. and Singh, D. 2014. Heterobeltiosis and standard heterosis for seed yield and important traits in *Brassica juncea*. *J. Oilseed Brassica* 5(2): 134-140.

Prakash, R. and Hinata, K. 1980. Taxonomy, cytogenetics and origin of crop Brassica, a review. *Opera Bot*. 5: 1-57.

Purakayastha, T.J., Rudrappa, L., Singh, D., Swarup, A., Bhadraray, S. 2008. Long-term impact of fertilizers on soil organic carbon pools and sequestration rates in maize-wheat-cowpea cropping system. Geoderma 144: 370–378.

Singh, R.K. and Chaudhary, B.D. 1979. Biometrical method in quantitative genetic analysis 2nd Edn, Kalyani Publishers, Ludhiana, New Dehli, India.

Singh, D. 1958. *Indian Rape and Mustard*. Hyderabad, Indian Central Oilseeds Committee. p. 105.

Singh, R.K., Lohia, R.S. and Singh, M. 2013. Study of gene action on inheritance of seed yield and its contributing traits in Indian mustard [*Brassica juncea* (L.) Czern and Coss]. *Progr. Res.* 8: 78-81.

Tiwari, A.K., Singh, S.K., Tomar, A. and Singh, M. 2017. Heritability, genetic advance and correlation coefficient analysis in Indian mustard (*Brassica juncea* (L.) Czern & Coss). *J. Pharmac. Phytochem*. 6(1): 356-359.

Willer, Helga 2011. Organic Agriculture worldwide. *In:* The World of Organic Agriculture. Statistics and Emerging Trends. IFOAM, Bonn and FiBL, Frick, pp.34-60.

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